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ADDRESS AT OPENING OF SESSION, 6 NOV. 1916

Douglas W. Freshfield, D.C.L., President

I DO not propose to make to-night any general statements on geographical events during the Vacation or on prospects for the Session. The one important event in exploration has been the rescue of Sir Ernest Shackleton's ship's company. It is our duty to offer without any delay our best thanks to the Government of Chile and Uruguay for the valuable services rendered by them in the rescue of the British explorers and sailors marooned on Elephant Island.

Our anxiety as to the fate of Sir E. Shackleton's party in the Weddell Sea, which was growing serious in May last, was partially relieved early in June by the news of the arrival of the leader with some of his companions in a boat at South Georgia, after the loss of his ship in the Antarctic ice. At our meeting on June 5 I was able to tell the Society what steps had been taken in this country to rescue the remainder of the crew, twenty-two in number, left under the command of Mr. Frank Wild on the desolate shore of Elephant Island.

Sir Ernest Shackleton, we are happy to record, has been able to add to his already high reputation for courage and perseverance by himself effecting this rescue. His first attempt in May (on board a little Norwegian whaler from South Georgia) was frustrated by the closing in of the ice round Elephant Island. The approach of mid-winter now increased the density of the ice, and made the dreaded sea south of the Horn extremely dangerous for small craft. Notwithstanding, Shackleton persevered in a second, third, and fourth attempt, in the hope of lighting on a favourable moment when a strong gale had driven the pack away from the land for a few hours. The second attempt, made in a trawler lent by the Government of Uruguay, brought him, on June 20, within 20 miles of Elephant Island, but the dense ice drove him back. The third attempt in the schooner *Emma*, placed at his disposal at Punta Arenas and towed part of the way by the Chilian Government steamer *Yelcho*, was beset by even greater difficulties and dangers, and after nearly three weeks at sea the little craft was compelled to return to Port Stanley in a damaged condition at the beginning of August. Meanwhile the Committee appointed by the Admiralty had equipped the *Discovery*, the ship of Captain Scott's first

expedition, and dispatched her on August 10 to make sure that the survivors (if by that time there were survivors) would be rescued early in October.

Sir Ernest Shackleton, however, had persuaded the Chilian Government to give him once more the use of the *Yelcho*, and on August 30 he reached Elephant Island on the morrow of a great gale which had driven off the pack and allowed the ship to touch the land and take off the whole party. The confidence we reposed in the skill and resourcefulness of Mr. Frank Wild, whom Sir Ernest had left in charge, has been amply justified; for he, with the assistance of the two surgeons of the Expedition, succeeded in keeping the party alive and in fair health during four months of semi-starvation, hardship, and what must have been unceasing anxiety. They could only hope, and the hope must sometimes have been strained to breaking point, that the little boat in which their leader had left on April 24 had reached some port whence help might be sent.

I ought perhaps to add a few words as to our home affairs. We are continuing—as many of our Fellows know from experience—to devote a large part of our house-room and the best energies of our reduced staff to doing work for the Government, much of which ought to have been done before the war. Owing, however, to our traditional attitude in times of peace, it has had to be done under great pressure. We are doing all we can to help to get it done, and we are deeply indebted to all those who are helping in this urgent national work. Is it an extravagant hope that a lesson has been learned, and that in the future the uses of geography both in war and politics may be more fully recognized at Westminster and Whitehall?

In conclusion I may remind you that two years ago I suggested to our Fellows that their subscriptions to the Society were not an extravagance but a contribution to the national resources and war activities. The relatively small number of resignations reported to the Council, coupled with the list of candidates read out to-day, is a gratifying answer to my appeal. The Society still numbers over five thousand members.

THE GREAT PASSES OF THE WESTERN AND CENTRAL ALPS

Douglas W. Freshfield, D.C.L., President R.G.S.

Read at the Meeting of the Society, 6 November 1916.

WHEN last year I opened the Session with a paper on that portion of the Alps which forms the Austro-Italian borderland and is included in the field of the present war, it was suggested to me that I might supplement it with some account of the more western portion of the chain. I have followed the suggestion, though I have my doubts whether,

in the lack of any immediate public interest in the region dealt with, I am wise in doing so. Moreover in the time at our disposal it is impossible for me to treat more than a single branch of the subject, and even so I can give only a most superficial survey of topics which would require several volumes to do them justice.

I propose therefore, after a summary sketch of the relation between natural features and political frontiers in the part of the Alpine chain between the Mediterranean and the Orteler group, to limit myself to a selection of notes on the Great Passes of the Western and Central Alps.

It is popularly held that in this region, with the conspicuous exception of Canton Ticino, where Switzerland thrusts herself down on the Italian lakes, the frontier corresponds with the watershed. This is the rule, but there are not a few exceptions to it. If we start from the Mediterranean coast we find that France, when in A.D. 1860 she gained the County of Nice, was not content with the old Roman frontier of Italy which ran down to the headland of Turbia, but annexed the district of Mentone and the glens behind it, once dependencies of Monaco. On the other hand, in order not to spoil one of Victor Emmanuel's favourite shooting-grounds, she left to Italy the headwaters of the Vesubia on the western side of the range.

These are the only divergencies between natural and political boundaries in the Western Alps. To find the next we have to look as far east as the Simplon Pass; there the pastures and villages above the gorge of Gondo, though on the Italian side, are Swiss. They are Swiss for a reason which will account for most of the irregularities we shall find farther east. A difficult gorge is a more practical barrier to human intercourse than an upland pasture.

Next we come to the great intrusion of Canton Ticino. From near the Gries Pass, just south of the source of the Rhône, the frontier of Switzerland diverges at right angles from the main chain and skirts the eastern edge of the Toce basin nearly to Lago Maggiore, which it crosses, then wanders among the foothills, giving all but the north-eastern corner of Lago di Lugano to Switzerland, before it strikes north along the ridge west of Lago di Como to rejoin the Alpine watershed close to the Splügen Pass. This intrusion may be held to be sanctioned by lapse of time. But it had its origin in force of arms. The Swiss—I call them Swiss, for though "Switzerland" did not form the official name of the Confederation until A.D. 1803, the name was in popular use from the date of the battle of Sempach (1386)—the Swiss Confederates finally occupied their present Cisalpine territories in A.D. 1512 as a payment for military services rendered to the Duke of Milan. Ticino has been at times on a small scale something of an Ireland to Switzerland. But it cannot be said that its inhabitants have shown any desire to share the burdens of the young Kingdom of Italy. They have found practical advantages in remaining Swiss. They are lightly taxed, their military service is never far from home, and their

frontier affords some of them almost unique opportunities for a profitable pursuit reputed formerly to have been the principal industry of my own county, Sussex—I refer to smuggling.

East of the Splügen, and along the frontier of Graubünden, we find several minor irregularities. The Val di Lei, though harbouring one of the sources of the Rhine, is Italian. This is because its pastures are owned by peasants of Val San Giacomo. Among primitive peoples the limits of pasture-rights form one of the earliest boundary-lines and one of the most eagerly insisted on. Fifty years ago the Suanetian communities in the Caucasus continually quarrelled and fought over them. The Tibetan claim to the bleak uplands of Lhonak at the back of Kangchenjanga rested entirely on this form of user. Next we find the head of the Bregaglia under the Maloja Pass and the valley of Poschiavo, both on the southern side of the Alps belonging to Switzerland, while the pastoral basin of Livigno, feeding a tributary of the Inn, is claimed by Italy. In each of these cases the cause of the abandonment of the mountain crest is the same as on the Simplon: a defile near at hand makes a better practical barrier than a broad and easy pass.

On the whole, then, we may safely anticipate that no change in the western and north-western frontiers of Italy will be caused by the present European convulsion. One happy result may be looked for: a relaxation of the mutual distrust which has made travel sometimes difficult and photography impossible in recent years on the Franco-Italian frontier. I must ask you to accept this as my excuse for being unable to show any photographs of the western passes.

I have not ventured to omit some reference to frontiers, because the topic is just now very much to the fore, and is likely to become still more so. But I must hasten to my main subject, Passes.

From among the various features of the Alps I have selected passes for this reason: they have a double interest, an interest human and historical as well as geographical and local. They are the features by which men are first and most naturally brought into contact with mountains. Consequently they come within the scope both of the geographer and of the historian, and form one of the many links between these two great branches of scientific inquiry.

In early ages mountains were as a rule objects of awe and reverence; they served as links between Man and the Unseen. They were looked on as "neighbours of the stars;" they inspired a primitive emotion, which at a later date found articulate and eloquent, if vague, expression in the poetry of Byron, Wordsworth, and Shelley. But in classical times the dweller in the lowlands, the commonplace man when he was in his market-day mood, looked on the greater ranges as an interruption and a nuisance. To Horace the Alps were tremendous; the Caucasus was inhospitable. Mountains were obstructions to be avoided, or got round, or over, as quickly as might be. The main object of humanity was to find the easiest

SKETCH-MAP SHOWING THE
GREAT PASSES OF THE WESTERN AND CENTRAL ALPS
TO ILLUSTRATE THE PAPER BY MR. DOUGLAS W. FRESHFIELD

way through them—in other words to invent passes, and in this we have on the whole been successful.

The Romans regarded the snowy belt that fenced in Italy from a purely practical point of view. They made roads over it, they built, and ornamented with triumphal arches, military towns situated in the high valleys, Susa and Aosta. They furnished the roads with rest-houses and post-houses, where horses could be changed. But they paid little or no attention to mountain scenery. It was not sufficiently humanized for them. Dr. Johnson's saying that every landscape is improved by an hotel in the foreground epitomizes the feelings of more than one century and people. The Italian Lakes were, it is true, reckoned by Virgil and Catullus among the glories of Italy, but not until their charms could be admired from under the portico of a villa. No Roman had a word to say in praise of Geneva or Lucerne. The glow of dawn on Monte Rosa found no favour in the eyes of the dwellers at Milan. Monte Viso, alone of Alpine peaks, won a place in classical literature. The Romans kept to the passes and left peaks to look after themselves. At a later date, when the Empire had fallen and its paved roads gone from bad to worse, the dislike of the dweller in the lowlands for the Alps was intensified. The pilgrims who wanted to get to Rome for Easter, and had therefore to cross the mountains at the very worst time of year, found the melting snows and avalanches an unmitigated nuisance. Divines, averse to the hardships of travel, went so far as to suggest that mountains were an interpolation of the devil in God's universe. They called the snows Monts Maudits, Accursed Hills; in short, they swore at them.

It was the fashion in Roman times to speak of the Alps as the rampart of Italy. They have at all times proved a singularly ineffectual one. It was not the Alp but the Apennine, running across the peninsula from Genoa to Rimini, that formed the limit of Gallia Cisalpina. That is why the Rubicon got its fame. Livy tells us how before Hannibal's time the Western Alps had been frequently crossed and recrossed by Gallic hordes. Hannibal, it is recorded, found tracks and guides ready to lead him through the mountains. On their eastern flank again the Alps could easily be turned by invaders approaching from the valleys of the Drave and the Save, and crossing the Carnic or Julian Alps to the lowlands at the head of the Adriatic. And so it has gone on through the centuries: Goths and Huns, Lombards and Franks, Holy Roman Emperors, French Kings, Napoleonic and Austrian armies have swarmed over their ridges. The Alpine Passes have served as the neck of an hour-glass; the human sand runs through them easily either way.

In the following notes I shall pay no attention to glacier passes, or climbers' passes, or side-passes over spurs and secondary chains. I confine myself to the Great Passes, by which I mean the passes over the main watershed which have been more or less continuously used not only for local purposes but by the peoples living outside the mountains and anxious to

traverse them. The Great Passes are the lines on which the traffic across a chain from the lowlands at its feet tends to converge in times of peace, over which the armies tramp in time of war. Their vogue will vary; one or another will come into use according to the changing starting-points and goals of their users, or to the artificial hindrances created by political frontiers and tolls. The making of a paved track and still more of a road for wheels will serve to concentrate traffic and lead to the relative disuse of neighbouring and unimproved gaps. When we begin to go into details we shall see how the Mont Genèvre was for the Romans the great western pass as long as they aimed at the Provincia (Provence); how the two St. Bernards came into use when their generals wanted to cross into Central Gaul or to Helvetia and the Rhine basin, and how a little later the Mont Cenis, lower and free earlier in the year from snow than the St. Bernard Passes, was found the most direct and convenient route between Lyons or Paris and Italy.

In considering the roads of the Western Alps we have to bear in mind that the track along the sea coast, the modern Cornice, if practicable, was not made convenient for military traffic until after the subjugation of the Alps by Augustus, who built the monument at Turbia to celebrate it. Some inland route had to be found through the recesses of the range.

Now in any map of the Western Alps—that is for my present purpose the part of the range that lies between the Mediterranean and Mont Blanc —it will be noticed that the principal valleys, with the exception of the upper course of the Durance, run more or less east and west, that is, transverse to the main crest or line of water-parting.

For the people on the west, in Provence and France, there were two great trenches which offered natural approaches to Italy, those of the Durance and the Isère. If you came from Provence or from Spain the Durance would serve, but where the valley made an angle to the north you might be tempted to keep your direction and get across by a short route to the Piedmontese plain, or you might follow up the stream and use the gap at its head. In one case you would take the Col de Vars and the Col de l'Argentière; in the other the Mont Genèvre: these are the two great Durance Passes.*

If however you came from Central Gaul you would naturally go up the Isère, until you found yourself called on to determine whether you would follow its zigzag course up to the watershed or strike boldly into the narrower but practicable valley of the Arc. You had to choose, that is, between the Little St. Bernard and the Mont Cenis.

Now let us fancy ourselves, not Gauls longing to rush Italy, but Romans eager to find a land-route to the Province, or to conquer Gaul. As we sit on the hill above Turin crowned by the modern Church of the Superga we

* The lower valley of the Ubaye is a difficult gorge. This is the reason for the use of the Col de Vars. All these passes have villages and cornfields a short distance from the top.

shall see away to the south of Monte Viso, where the plain runs wedge-like into the hills (hence the name of Cuneo), the mouth of the valley of the Stura. Right in face, conspicuous and tempting, lies the gap of the Dora Riparia leading up to Susa, further to the north-west the opening of the remote valley of the Salassi, Val d'Aosta.

Now each of these adits corresponds to one or more of those on the west of the chain; the Val di Stura leads to the southern Durance Pass, the Col de l'Argentière; the Susa gap leads to the northern Durance Pass and the Arc Pass, that is to the Mont Genèvre and the Mont Cenis. Val d'Aosta leads to the Great and Little St. Bernard.

Dealing therefore with the mountain routes we find that there are two main valleys west of the chain, those of the Durance and the Isère leading respectively on the other side into the countries of the Taurini and the Salassi; and this is what Polybius, as reported by Strabo, knew. He tells us there are four passes in all over the Alps, that along the coast, that through the Taurini, that through the Salassi, and then he leaps all the Central Alps and mentions the pass through the Noric Alps.

Before we deal with the western passes in a little more detail, let me summarize my impressions of the state of the tracks in pre-Roman times. Livy tells us that Hannibal's passage was not a novel feat, that the tribes had been in the habit of crossing to and fro. Livy also tells us that the Keltic tribes passed down Gaul till they came to lands already occupied and ill suited for pasture. Then may we not picture them drawn by the fame of Italy, marching up the broad trench of the Durance, until it turned north and was to all appearance closed by the snows of Dauphiné. Here at the angle they had a choice: they might either turn their backs on the sun and follow the river to its source, in which case they would gain the Mont Genèvre, or they might climb over a broad down into the upper basin of the Ubaye (near where Barcelonette now stands), and then with an inappreciable second ascent reach the Alpine watershed at the Col de l'Argentière.

When the Romans established themselves on the nearer side of the Alps they had their headquarters at Cremona and Pavia, their main sub-alpine military posts at Turin and afterwards at Aosta. The broad gap from which the Dora Riparia issues, the most conspicuous feature in the view from the plain, would naturally draw Pompey to the Mont Genèvre, and Cæsar to the Mont Cenis when he wanted to go north to Gallia, and not to the Provincia, or Hispania. A few years later when the Salassi had been conquered and Aosta (Augusta Prætoria) founded, the two St. Bernards gave access to the Rhône Basin and Helvetia.

Now let us move on and see what Varro, the librarian of Augustus, the most learned man in Rome of his day, an encyclopædic intellect, has to say about the Passes of the Western Alps. In the commentaries on Virgil of Servius, a fifth-century grammarian, we find the following fragment of Varro. Its authenticity has not hitherto been seriously

questioned. Dr. Smith in his well-known 'Dictionary of Classical Geography' quotes it in full with the surprising comment, "a passage in which there appears to be much confusion." To any one who knows the Western Alps intimately there is no confusion whatever in this very plain and intelligible statement.

> "The Alps can be crossed in five ways; the first next the sea, the second which Hannibal crossed, the third by which Pompey went to the Spanish War, the fourth by which Hasdrubal came from Gaul into Italy, the fifth, which from once having been held by Greeks is called the Grecian Alp."

Now there is no doubt about the first and fifth of these passes, the Cornice and the Little St. Bernard. Must we not suppose that the other three are placed in their geographical order from south to north? It is, to say the least, a very plausible supposition. If we do so we must identify the remaining three passes with the Col de l'Argentière, the Mont Genèvre and the Mont Cenis. We have abundant evidence that Pompey's pass was the Mont Genèvre. But here my learned and peripatetic friend, Mr. Coolidge, may ask me, Why identify Varro's passes with these modern passes, when there are a dozen other routes by which the Western Alps can be crossed without danger? I reply, Because the experience of nearly twenty centuries has shown these to be the preferable main routes through the mountains; because they are the passes Napoleon, that most practical of field-geographers, recognized; because when Brockedon,* more than eighty years ago, published his fine work on the Passes of the Alps, these were the five he selected for illustration; because they are at this day the only carriage roads across the Western Alps.

Political and military considerations or frontier difficulties may have tended from time to time to bring one or other of these passes into greater use and prominence, but traffic has on the whole stuck steadily to these five routes whether in the days of Rome, or of Carlovingian Emperors, or of mediæval pilgrims, or of French invaders of Italy.

Now the modes of transit have no doubt undergone many modifications between the rude paths trampled by the invading Gauls, the harsh *pavés* of the Roman empire, the splendid high-roads of Napoleon, and the tunnels of to-day. But do not imagine the Alps even in very primitive times as pathless. Wherever in mountain regions there are inhabitants and

* I have mentioned Brockedon, and it is proper that we should do him some tardy justice here. His fine work on 'The Passes of the Alps' is too much neglected. He was an artist of merit, a portrait and landscape painter who illustrated his own books, and an energetic alpine explorer at a date when the Alps were little known. His portrait is among those of painters in the Uffizi at Florence. He was responsible for a great part of the early editions of Murray's 'Switzerland Savoy and Piedmont' (1838), and he was also one of the founders of our Society and a member of its first Council. Can any one furnish information as to what has become of the originals of the illustrations to his 'Passes of the Alps' which were "sold to Lord Vernon for 500 guineas"? (See Dict. of British Biography).

pastures, there are paths. I have found them in the Caucasus, the Himalaya, the Atlas, all over East Africa, everywhere till I got to the Mountains of the Moon, where the jungle reaches to the snows. The Romans laid down their Strata Romana; that was the name given in after centuries to the Mont Cenis. Very little improvement was made for 1800 years. The modern *pavés* throughout the Italian Alps are bad imitations of Roman road-making. We have most of us uttered impatient exclamations while descending under an August sun those endless stony staircases.

It was a long time before any one traversed the chain on wheels. I have little doubt that, when he wrote his grammar while crossing the Alps, Cæsar rode in a litter. The English pilgrims in the Middle Ages tramped and suffered. Wealthier people, Popes, Savoy princes and their ladies, rode in litters hung with rich trappings. Ordinary travellers hired *chaises à porteurs*, rude sedan chairs. The men who carried these were known both on the Great St. Bernard and the Mont Cenis as "Marrons." No one has yet found a satisfactory derivation for the word. The best dictionaries fail us. Some suggest these porters were captive Moors, or perhaps natives of the Maurienne? There have been all sorts of wild guesses; I have made some myself.

When carriages came in, they came in first on the Brenner and the Mont Cenis, though on the latter pass they seem to have been taken off wheels and lifted over from Lanslebourg to Susa. De Saussure writes of going round from Geneva with his family by the Brenner in case the Mont Cenis was not open. It does not seem to have occurred to him that there was any intermediate course. Yet we read in exceptional cases of wheels crossing the Little St. Bernard in the eighteenth century.

And then appeared the great constructive energy that made all Europe move on, that improved laws, roads, and maps, destroyed boundaries, and brought the Alps for the first time since Charles the Great under one master—Napoleon. His splendid military road of the Simplon I shall refer to later on. Between A.D. 1800 and 1810 he made roads over the Mont Genèvre and the Mont Cenis, and surveyed and planned roads across the Little St. Bernard and the Argentière. The Cornice road had been begun by his orders in 1802, but was not completed until after his downfall. There was hardly a great pass in the Alps which did not echo to the tramp of his armies. The central knot, the St. Gotthard and Glarus Alps, was desperately fought over; the Splügen was crossed in the snow by Macdonald.

I shall now go on to take the passes more in detail, and I must first say something of the maritime pass, the Cornice. The motorist who glides in his own dust along the very modern coast road from Nice to Monte Carlo may deny that there is a pass. But those of us who have driven over the mountain—where at Turbia the "Tropæum Augusti," the monument erected in honour of the subjugation of the Alps, still shows its Roman strength—know that the old Alpis Maritima was what Coryat would have called "hill enough for any traveller." No doubt under the Roman Empire the

coast road was fairly well kept, but in mediæval times, as Dante tells us, the track from Lerici to Turbia had become a proverb for its ruggedness.

Our second pass is the Col de l'Argentière. It was undoubtedly known to the Romans. Latin inscriptions have been found in the villages on both sides of it. But it does not figure in the Itineraries that have come down to us. As a consequence it has for the last eighty years—since Brockedon included it in his 'Passes of the Alps'—frequently been ignored by historical writers. Dr. Scheffel, in the valuable work lately noticed in our *Journal*,* even goes out of his way to give reasons why no pass was wanted, or found, in the broad interval between the coast and the Mont Genèvre. I do not think these reasons satisfactory. He alleges the very easy nature of the Cornice road. In winter, it is true, the coast road is not liable to be blocked by snow. But at any other season the perpetual ups and downs of the Roman track, a veritable switchback all the way from Albenga to Nice, rendered it far more arduous than an average alpine pass. Dr. Scheffel goes on to discredit the Roman origin of Cuneo and Saluzzo, forgetting, surely, that many Roman inscriptions in both of these towns are recorded in Mommsen's *Corpus Inscriptionum*.†

Passing over many centuries we find in A.D. 1415 evidence of the traffic across the Col de l'Argentière. In that year the magistrates of Larche, the village nearest the pass on the west, were heavily fined for not maintaining the poles that served to mark the track in winter, and twelve years later those of Vinadio suffered similarly for neglect in the repair of a bridge.

In modern times the Col de l'Argentière has been primarily a military and peasant's pass, and its history is mainly concentrated in the sixteenth and seventeenth centuries. Such obstacles as it presents lay not in crossing the watershed, which is a flat meadow with a lake, but in the defiles on either side. The traveller by the modern road has difficulty in realizing its former terrors; but Brockedon, a capable witness, is emphatic as to their reality even in the last century. This is his description of the gorge on the east side, in the valley of the Stura:—

"After passing the village of San Bernardo, the traveller enters a fearful defile called The Barricades. The road is carried along a shelf of rock above the river cut out of the precipices which darken and overhang the ravine and present an almost impregnable barrier to the passage of the valley." And Prof. Spenser Wilkinson quotes Bourcet, a famous French military writer, as instancing the Barricades as a typical example of a position which a small force may hold against a whole army.

* 'Die Verkehrsgeschichte der Alpen.' Dr. Scheffel. 2 vols. Berlin, 1908–1914. I may correct here two obvious misprints in the notice of this work, "l'Arche" for Larche, and "Albula" for Aprica (*Geog. Jour.*, vol. 48, pp. 136–7).

† I pass over the Col di Tenda because it leads not into the County of Nice (now the Department of the Alpes Maritimes) but into the seaward glens east of Turbia, and, as Mr. Coolidge writes, "has been chiefly useful to the local lords." See Mr. Coolidge's articles in the 'English Historical Review,' vol. 31.

On the French side the Ubaye below Barcelonette plunges into a wild ravine. This used formerly to be avoided by the passage of a grassy ridge—the Col de Vars—500 feet higher than the main pass leading to the Durance. As I have said, the ascent to the Col de l'Argentière from the point where the Col de Vars track joins the Ubaye is so slight that in point of fact the route is hardly to be reckoned as a double pass, resembling in this respect the combination of the Julier and the Maloya. On both passes villages and cornfields are found within a few hundred feet of the summit ridge.

Paulus Jovius tells the story of Francis the First's passage in A.D. 1515 before the Battle of Marignano, and Sismondi has dilated on it with an utter lack of geographical knowledge. Francis had with him an "incredible number" of carriages and powder-waggons, 72 large cannon and 300 smaller pieces drawn by 5000 horses. The northern passes were in the hands of the enemy. The host marched from Grenoble up the valley of the Drôme, crossing to that of the Durance. At Embrun they rested and revictualled. Thence they set out with five days' provisions to traverse the Alps. They forded the Durance at Guillestre and crossed the Col de Vars to the upper Ubaye. On the descent they encountered the Rocher de St. Paul, which they made passable for cannon by blasting.

Next day they traversed the Col de l'Argentière and camped on the Italian side. They had further difficulty at the Barricades, but on the third day from Guillestre the defile was overcome and the army issued into the smiling open valley of the Stura, which Brockedon truthfully describes as one of the fairest scenes in Piedmont in a passage which may recall Livy's phrase in the narrative of an earlier military adventure.

Indeed the coincidences between this march and that of Hannibal stand in no need of pointing out: the provisionment in the Durance Valley, the passage of the river by a ford, the difficulties at the Rock, the Barricades met with on the descent. But I will not plunge to-night into the interminable discussion on Hannibal's Pass. The Col de Vars and Col de l'Argentière were again in A.D. 1692, 1700, and 1744 crossed and recrossed by armies. The story of the last campaign is told by the Marquis de St. Simon. In this the Barricades were turned by sending troops by a circuitous track over the hills.

When we come to later days, we learn from the Marshal de Pezay that in A.D. 1775 the Col de l'Argentière and the Col de Vars were both practicable "for carriages of every description." But there can never have been more than the rough country road which remained till the end of the nineteenth century. We find Napoleon ordering a high-road over the pass with the title of *Route Impériale de l'Espagne en Italie.* But his road was not made until the end of the nineteenth century.

The Col de la Traversette (9679 feet) under Monte Viso is noteworthy for the tunnel pierced a few feet below its top in A.D. 1480 by Louis XI. of France and the Marquess of Saluzzo in order to promote trade between

France and Italy. But it is too lofty to be used except under political exigencies, and is not a great pass.

The story of the Mont Genèvre might occupy my whole time. It was the great Roman Pass to the Province, made by Pompey and improved by the local kinglet who gave his name to the Cottian Alps. We have full details of its stations in the Itineraries. It was at one time peculiarly the French Pass, the Alps north of it on both sides being till recently possessions of the House of Savoy. In the twelfth century a Pope and an Emperor crossed it. Charles VIII. and Louis XIII. used it. But it could not compete successfully for general traffic with the next pass on our list, the Mont Cenis.

The Mont Cenis is the most direct route from Central France into Italy. Its disadvantages were the steepness of the track above Susa on the Italian side, and the narrowness of the Arc valley, which is very liable to spring avalanches. The pass is not mentioned in the Itineraries, and there is a lack of local evidence of regular Roman use, though Roman remains have been found at St. Jean in the Maurienne. Gibbon thought Constantine crossed the pass in A.D. 312; but this is unproven. It is incredible, however, that the Romans for generations should have garrisoned and adorned Susa without discovering that one of the easiest passes of the Alps lay within a day's walk of their quarters. Again, long before the sixth century, in very early Christian times, the Maurienne was both ecclesiastically and politically connected with Turin. This fact is surely sufficient circumstantial evidence that the two sides of the chain were connected by an easy and frequented pass.* The first mention by name of the Mont Cenis is when Pippin crossed it in A.D. 756. It became the favourite route of the Frankish kings, and, when they wanted to pass the Western Alps, of the Holy Roman Emperors. Pious pilgrims and Court ladies had adventures on it. They were taught to glissade on skins, or toboggan, from the top down to Lanslebourg. The pass had one military disadvantage. The defile below Susa was in the days before cannon very defensible. It was called the Gate of Italy. Charles the Great thought it worth while to send half his army round by the Great St. Bernard in order to be sure of taking the Lombards in the rear at this spot. Note that on all the western passes the military defence of Italy was not on the watershed, but in a gorge on the Italian side; on the Argentière that of the Barricades, on the Mont Genèvre and Mont Cenis that of La Cluse, on the two St. Bernards that of Fort Bard.

In much later days many men of letters sought Italy by this route; to mention only a few, Coryat, Montaigne, Rousseau, Gray, and Johnson's friend Mrs. Thrale. Perhaps the most entertaining account of the passage is that of Coryat the Elizabethan traveller, the guest and butt of the wits

* For an account of the early connections of the Maurienne with Susa and Turin see an article "The See of Maurienne and the Valley of Susa," by R. L. Poole, *English Historical Review*, vol. 31, No. 121.

EW ALONG WATERSHED, MONTE DELLA DISGRAZZIA, SHOWING ICE-FREE UTHERN FACE

'BENCHES' IN THE VAL DES BAGNES

GORGE CUT BY WATER LEAVING BENCHES AND ALP

A VALLEY OCCUPIED BY A GLACIER AND A RIVER SHOWING RELATIVE RATE OF EROSION

at the Mermaid Tavern. He took about six hours from Lanslebourg to Novalesa, the great monastery above Susa. He rode up, but had to walk down, where "for the space of 7 miles he continually descended headlong." "The waies were exceeding uneasy. For they were wonderful hard, all stony and full of windings and intricate turnings of which I think there were at least 300 before I came to the foot. Still I met many people ascending and mules laden with carriage and a great company of dun cattle driven up the hill with collars about their necks." After his return Coryat threatened a certain "vilipendious linendraper" with an action for belittling his Alpine feats. I should have given evidence on the side of the linendraper.

Mrs. Thrale's (or rather Mrs. Piozzi's) reflections on the passage of the Alps are not without interest, for she catches the sentiment of the eighteenth century on the turn. She lays down that in a mountain country "horror constitutes beauty." She finds that "such tremendous appearances inspire a satisfaction that there is something great to be seen on earth" and proceeds to a rather elaborate piece of word-painting of Savoyard scenery, while she declares that "the Italian side of the Alps is an astonishing journey and affords the most magnificent scenery in nature."

The Little St. Bernard was a convenient cut from the Cisalpine to the Transalpine dominions of the House of Savoy. It links two great valleys, those of the Isère and the Dora Baltea. It had a hospice on the top, but its importance seems at any rate after Roman times to have been more local than international. It could not compete with the Mont Cenis when that route had become established. For one thing it holds the snow later in the year owing to its greater height and more northern position. It did not become a carriage road till A.D. 1861, but the old track was so good that in 1824 Brockedon was able to get a light carriage over it on its wheels. Its literary fame has come from the fact that Brockedon, Dr. Arnold, Bosworth Smith in this country, and Mommsen in Germany—I mention only a few out of many names—have proclaimed, I cannot say argued, it to be the Pass of Hannibal.

As I said before, I am not about to plunge into this old world controversy. I shall not attempt to persuade you that I know the pass which Hannibal crossed. But I do know a pass he did not cross, and that is the Little St. Bernard. This can be shown on the evidence of Polybius alone. No ingenuity can force his description of the descent into Italy to fit in with the long defiles of the Val d'Aosta.*

But let us dismiss Hannibal and get on to the Central Alps—what we call nowadays the Swiss Passes. For my present purpose I shall abandon the division between the Western and Central Alps (the Simplon) adopted by our former Fellow Mr. John Ball in The Alpine Guide and treat the Pennine chain as part of the Central Alps. In this region there were in

* See on this question 'Hannibal's March through the Alps' (Spenser Wilkinson; Oxford, 1911) and 'Hannibal once more' (D. W. Freshfield; London, 1911).

the earliest times no great roads of national migration or commerce such as the Durance Passes in the Western Alps, or the Brenner, Auf der Plecken, and Birnbaumer Wald in the Eastern Alps.

Look for a moment at any good map of the Central Alps. The feature that must first strike the observer in this part of the range is the parallelism of the great valleys to a double chain. It is a ridge and furrow arrangement with interruptions. Unless you go in through the gap of the Rhône at St. Maurice, or that of the Rhine near Ragatz, you see at first no way of getting from the plains of Switzerland to Italy without crossing at least two passes. Closer examination reveals the spot where the Reuss pierces like a needle the northern ridge and leads to the St. Gotthard. But for centuries this gap remained practically impassable owing to the gorge of Schöllinen. Here then you have the three main lines of approach settled, but the actual point in the ridge to be crossed has varied according to local obstacles and local conditions—physical and political. The Rhône Pass *par excellence* was at one date the St. Bernard, later the Simplon. Minor snow-passes, the Col de Fenêtre, the St. Theodul, and the Monte Moro or Antrona Pass were from time to time brought into use, but mostly for local traffic.

Do not run away with the idea some writers seem to have that because a pass is not in the classical Itineraries it was wholly unknown or untraversed. It may be a help to realize what the state of the Alps was in early Roman times if we compare it with the state of a newly conquered region like the Caucasus fifty years ago. There were not a few passes in the Central and Western Caucasus known to the Russians and occasionally used for military purposes which were not to be found in their official Itineraries, and were ignored by general geographers.

The Great St. Bernard has a varied story. The Romans had a garrison at Aosta and another at Octodurum, now Martigny. At Agaunum, now St. Maurice, the gate of the Valais, where "a key unlocks a kingdom," the Theban legion is said to have been decimated for refusing to pay divine honours to their emperor. Fugitives from it, according to legend, supplied those queer saints with water-buckets and sore legs who figure in faded frescoes on the walls of wayside chapels. They were the evangelists of the Western Alps.

The Romans as their empire grew needed a direct pass to Helvetia and the Rhine, and they habitually used the Great St. Bernard. They built on the top a temple, or a shrine, to the local deity Jupiter Penninus, and they erected a hospice at St. Pierre, or Peter's Castle as a monk of Canterbury calls it, on the north side. The Romans provided such refuges at fixed distances on most of their main Alpine roads. After the break-up of the Roman Empire the Val d'Aosta fell not to the Lombards but to the Burgundians, and the frontier of Italy was not on the Alps but in the subalpine gorges at Fort Bard on the St. Bernard and Aviliana on the Mont Cenis. The pass was in constant use. In the eighth century Bede tells us

many English nobles and common folk, men and women, made the pilgrimage to Rome. Some of them may have met, in the winter of A.D. 801, the Jew Isaac leading an elephant as a present from Harun al-Rashid to Charles the Great, surely the first of his race since Hannibal's to cross the Alps. It seems to have been Charles the Great's favourite pass, and many Holy Roman emperors trod in his footsteps. Our king, Canute, who himself in A.D. 1027 crossed the Alps, remonstrated with Pope and Princes against the extortions to which our pilgrims and merchants were subjected in the gorges of the Alps.

From the ninth and tenth centuries onwards the Great St. Bernard was much favoured by British and even Icelandic pilgrims. They utilized the waterway of the Rhine as far as Basle, and then crossed the west of Switzerland by the Roman road passing Aventicum. At Vevey they prayed in the church of St. Martin, the patron saint of travellers, for a safe passage of the Mount of Jove. The monastery of St. Bernard (founded in A.D. 1008) had some curious connections with England. It owned the Chapel of Romford and the Hospital of Havering in Essex, which was bought from it by William of Wykeham and presented to the College at Winchester, which I believe still holds it.

Our countrymen did not enjoy the passage of the Alps; one of these tenth-century pilgrims put into the charters he drafted the following imprecation: "May he who breaks this covenant be tortured by the bitter blasts of glaciers and the Pennine army of evil spirits." But they were still more afraid of the Saracens who infested all the western passes, the freebooters who had found a footing in Provence. Very few of the Englishmen who frequent the Riviera have explored their lair, Fraxinetum, now La Garde Freinet, on the crest of the Montagne des Maures. On a crag projecting from the skyline some 7 miles to the north of the natural harbour of St. Tropez, and overlooking on the other side the broad valley which slopes down to Frejus, the freebooters established their eyrie. All that remains of it are a few walls and cisterns cut deep into the natural rock. Hence their bands went out to sweep the passes of pilgrims, or to pick up and hold to ransom a fat abbot. They got as far as the Great St. Bernard and even farther, into Graubünden; though in some of the chronicles it is difficult to distinguish their raids from those of freebooters, Hungarian and others, from the north or east.

We may dismiss the legend which assigned to the Saasthal names of Alphubel and Mischabel an Arabic origin. There was once a professor of Arabic in one of the universities of, shall we say Laputa, who thought Distel Alp might also be Arabic—he found in it a corruption of words meaning "the haunt of an eagle." The donkey who carries up the herdsman's packs to the Alp might have furnished him with a simpler derivation. As to Pontresina and Castel Mur in Graubünden, one is an Italianized form of the Romansch Punt Raschuns (Pons Rhætiæ) and the other marks the Roman station "Ad Murum" on the Italian side of the

Septimer, where a wall, still existing, served to mark the frontier of Prægallia (Bergell) and bar the entrance to Italy.

The Saracens were finally driven back seawards about 970 A.D. A few years later St. Bernard of Menthon founded the monastery on the top of the famous pass and substituted his name for that of Jupiter Penninus.

After the tenth century, when the danger from freebooters was removed, and the passes of the Western Alps resumed their place as roads to Rome, the Great St. Bernard became a frequented commercial route, and the monks and their famous dogs found plenty to do in the winter and still more in the dangerous spring months.

I must hurry over its later story, quoting only a few scraps of curious detail quarried by the late Signor Vaccarone out of the accounts in the State archives at Turin. From these we learn that in the fourteenth century bales of English wool passed in quantity through Martigny, and paid an impost per bale for the maintenance of the road as far as Riddes. Travellers and their guides were also taxed. The inhabitants of St. Rhémy were granted an exclusive right of acting as guides—a sort of forerunner of a Guides' bureau. Easter presents were sent across the Alps to the Court of Savoy. The Bishop of Sion sent on one occasion twelve marmots, the Prior of Chamonix in A.D. 1375 twelve baskets of what is described as "most exquisite butter." This is notable as an early proof of the easy relations of Chamonix with the outer world. The "Signori" of Val d'Aosta sent still more mixed presents to their sovereigns; the Countess at the same date received some barrels of the muscat wine of Chambave and several bears, the Count a number of bouquetins.

One more note. In January A.D. 1434 Amadeus the Eighth, anxious to assist his general in an attack on Chivasso, succeeded in sending a heavy piece of artillery, a *bombarda*, over the Great St. Bernard, thus anticipating by centuries the feat of Napoleon.*

In May A.D. 1800, before the snows had fully melted, the monks saw a strange sight—Napoleon and his army on the way to Marengo. Fighting was going on in the Maritime Alps and on the Genoese coast between the French and Austrians, and Napoleon having collected his army at Dijon was able to mislead the enemy and burst from an unexpected quarter on their flank into Piedmont. Some historians have disparaged this feat. Those of us who have crossed the Alps in May, or even in June, by one of the Great Passes and have been tilted out of our sledges into soft snow-beds will not think so lightly of it. I have here a medal of the time, in which Napoleon is represented as breaking the rocks not with vinegar but in a Jovelike way with flashes of lightning. On the reverse is the head of the stately Josephine. In fact Napoleon, in place of leading the way, seems to have waited three days at St. Maurice until his vanguard had safely reached Aosta. Moreover in place of caracoling over the

* I Principi di Savoia attraverso le Alpi nel Medievo (1270–1520); Torino, Via Alfieri 9 (Club Alpine), 1902.

TH

THE MALOJA WALL WITH THE SEPTIMER PASS IN FOREGROUND

THE BERNINA PASS, SHOWING THE TRUNCATED HEADWATERS OF THE INN

THE UPPER STEP ON THE SAN BERNARDINO PASS

Alps on a charger the hero rode a led mule. History might have missed this detail but for the circumstance that Napoleon showed his gratitude to the animal's leader by conferring on him a pension. It is curious that the Great St. Bernard was one of the last additions to Alpine carriage roads, the new road having been completed only in the present century.

I pass on to the tracks other than the Great St. Bernard between the Rhône Valley and Italy. For centuries the St. Bernard found no rival among the possible passes of the Pennines. The Col de Fenètre, the Collon and the St. Theodul, all glacier passes, might be crossed by peasants, pedlars, or refugees, but they were never more than byeways. None of them are difficult, but on the two latter crevasses may be met with. Consequently we learn from Simler's *Historia Vallesiæ* that already in the sixteenth century Zermatt had learnt the use of glacier guides, ropes, alpenstocks, and snow spectacles.

The St. Theodul was from A.D. 1538 known as *par excellence* the Glacier Pass, Gletscher Mons or Monts Roeses. Roesa or Ruize is the Val d'Aostan term for a glacier. It is used in De Saussure's 'Voyages.' As in so many cases the name of the pass slowly got itself attached to the mountains about it, and finally to the highest of them; hence we have our Monte Rosa. Roman coins going back for six centuries from A.D. 400 have been found on the crest. It was fortified in A.D. 1688 to prevent the Waldenses returning by it to their native villages.

Far more important passes were the Monte Moro and the Antrona Pass leading, like the Simplon, from Canton Valais to Domo d'Ossola and Lago Maggiore. They were rough mule-paths, but the first to the east of the great ice-barrier of the Pennine Alps, the longest continuous ice-field in Central Europe. They were superseded by the Simplon. There is no satisfactory evidence that the Simplon was used by the Romans. The gorge of Gondo on its southern side was a formidable obstacle. Until relatively recent times what traffic there was avoided it by a second pass leading from the head of the gorge through Val Bugnanco to Domo d'Ossola. The path, before Napoleon made his road, is described as a dangerous track. It served however as a useful trade route, and de Saussure, who crossed it, speaks of it as a good mule-road though narrow in places. The first hospice on it was built in A.D. 1234. To the commercial importance of the Simplon as a road to Milan in the sixteenth and seventeenth centuries the stately house of the Stockalpers at Brieg bears witness. Evelyn gives us an interesting account in his diary of his passage on horseback in A.D. 1646. It is worth noting that he crossed in spring and not in autumn, as owing to an interpolation Dr. Arnold was led to think. The error led Dr. Arnold into speculations on a change in the climate of the Alps which had no solid foundation. Napoleon, who found once enough for the St. Bernard, made the fortune of the Simplon by his new road, and from his day it has eclipsed all the other passes between the Mont Cenis and the Brenner as an easy way to Italy.

Farther east the route of the Grimsel and the Gries, a double pass, carried much traffic from Canton Bern into the Milanese, and bands of hungry peasants trooped over it in years of famine from the Vale of Meiringen to buy meal for their families.

There was a vague but general impression in the Middle Ages and down to the eighteenth century that the St. Gotthard group was one of the loftiest parts of the Alps. The logical ground for it was that the great rivers, the Rhône and the Rhine, have their sources there, and that rivers flow downhill. Its wild character may have helped. Near it, as in a sort of No Man's Land, many Bishoprics met—Chur, Constanz, Milan, Sion, and Lausanne: east of it was Germany, west Gallia. Before a passage was established from north to south there was a certain traffic across it from east to west by the Oberalp and Furka, to which Andermatt and Hospenthal owed their origin.

I have already pointed out the natural advantage of the St. Gotthard in its enabling a traveller to take a straight course through the Alps from Basle to Milan without crossing more than one mountain ridge. But this advantage was for centuries more than counterbalanced by various obstacles. The shores of the Bay of Uri were practically pathless; this perhaps helped to keep off armies and Emperors who travelled with troops of horsemen. There was a more serious obstacle in the gorge below Andermatt. So formidable was it that the Urseren Thal was for years attached to the Convent of Disentis in the Vorder-Rhein Thal, and only later became part of Canton Uri. Before the Urner Loch was pierced in A.D. 1707 all traffic had to pass over a wooden gallery, the *Stiebende Brücke*, the spray-washed balcony confused by Schiller with the original Devil's Bridge. It is not till the beginning of the thirteenth century, A.D. 1236, that we hear of traffic over the St. Gotthard, and from that time forward the traffic was almost entirely commercial. The merchants of Lucerne, who had previously gone round by Chur and the Septimer, began to use it as a road to Italy. The rise of the St. Gotthard corresponds with the growth of Bern in the thirteenth and fourteenth centuries and the commercial rise of Milan after the peace of Constanz. It was pre-eminently the Milanese Pass. The pasturages on the top and the southern slope belonged to the Archbishop of Milan, who in A.D. 1431 enlarged a hospice for travellers that had been founded about 1330. Then in the fifteenth century the Swiss got hold of Val Leventina and, after some reverses, made good in A.D. 1512 the conquests which they hold to this day as Canton Tessin. In the Napoleonic wars this region saw some of the bitterest mountain fighting between the French, Austrians, and Russians.

The St. Gotthard was not made into a proper carriage road till A.D. 1820; but in the preceding century, in A.D. 1775, De Saussure met an Englishman on the top who had succeeded in driving or lifting a light carriage over it. This Englishman was Charles Greville, the father of the Diarist. The exploit cost him £24; the services of eight men as well as four horses were

found necessary. About the same date the annual traffic over the pass amounted, we are told, to 40,000–50,000 travellers, 7000 tramps, and 150,000 animals. Its railway is now by far the most stupendous example of modern mountain engineering in Europe.

The next pass to the St. Gotthard, the Lucmanier, the Pass of the Great Forest, Lucus Magnus, leads from the head of the Vorder-Rhein Thal to Bellinzona. The famous convent of Disentis was its starting-point. It sank in commercial importance as the St. Gotthard rose. But it had been from early times a frequent route of the Holy Roman Emperors on their way to Italy. It was crossed by emperors in A.D. 965, 1004, 1146 and 1186, and again in 1431. But it was the Abbot of Disentis (a Prince of the Empire) who did most to keep it open by building hospices on the mountain, and in A.D. 1780 started a wheel road. The Abbey was ruined by Napoleon, and the road was not completed for ninety years, till A.D. 1871.

The San Bernardino (named after the Sienese saint) was only occasionally used. It was first called "Mons Avium," and may have been known to the Romans. Horace's choice of an appropriate epithet for the source of the Rhine—*luteum* (muddy)—looks as if some Roman had been near the spot.* The last two passes lead to Bellinzona and Lago Maggiore. The remaining passes of the Grisons all concentrate on the head of the Lake of Como. The difficult gorges of the Hinter-Rhein rendered the Splügen less serviceable than the Septimer. But it was well known to the Romans and in the Middle Ages. Leonardo da Vinci in his notes gives some amusing details of a trip he made towards it. In the Val di Chiavenna, he tells us, there are deer, bouquetin, chamois, and terrible bears, but you have to climb on hands and feet to catch them. From mile to mile there are good inns and good living at four soldi the reckoning, and up at the head of the valley, that is on the ascent of the Splügen, "waterfalls of 700 feet which it is a pleasure to see"—no doubt the fall of the Madesimo, which the old road passed under.

The passage of an army under Marshal Macdonald in the winter of A.D. 1800 was one of the most daring feats of the French forces in the Alps. The modern carriage road through the Via Mala and over the pass was not completed till A.D. 1823. The Splügen is one of the passes that illustrates well the formidable barrier made by gorges and how long they remain impenetrable. Some of its traffic is said to have gone over a second high pass into a side glen of the Vorder-Rhein in order to avoid the Hinter-Rhein defiles.

The most direct pass from Chur to Chiavenna is undoubtedly the now

* The received text reads: "Defingit Rheni luteum caput," and the commentators suggest that the minor poet to whom Horace is referring showed his bad taste by libelling the source of the Rhine, which they imagine to be clear. But "defingere" is a verb found hardly anywhere else in the classics. "Depingit" would seem to me a reasonable emendation.

neglected Septimer. It found a rival in the, for travellers from Lago di Como, more circuitous Julier. The two passes are practically of the same height; that both were in use in Roman times the name of the hamlet in the Oberhalbstein where their tracks rejoin, Bivio, affords sufficient proof. But neither is shown in the Peutinger Table, and only one of them is mentioned in the Antonine Itinerary. This gives the distance between Admurum (Promontogno) and Tinnetio (Tinzen) as XV miles. In fact the distance by the Septimer is about 25 Roman miles. A second X may have been dropped out. By the Maloja and Julier the distance is nearly double. The latter route involves going round two sides of a triangle in place of along the base. The Julier was probably used chiefly in combination with the Bernina. Dr. Scheffel however is at pains to maintain the paradox that the Julier was the older and more frequented pass. His principal argument, the finding near the top of a hoard of Roman coins, seems inconclusive. A similar discovery has been made on the St. Theodul, which was certainly not the first or favourite Roman pass over the Pennine Alps. In the Middle Ages the Septimer ranked with the Great St. Bernard and the Brenner as a pass for emperors. It was under the special patronage of the Bishops of Chur, who derived a revenue from its tolls. One of them used his position at the Imperial Court to obtain a prohibition against travellers using any other pass in this region! The unfortunate traveller over the passes in the Middle Ages was met at every turn by tolls and taxes on his goods, levied by bishops, convents, or counts, and this naturally led to his at times using byeways.

The natural advantage of the Septimer lay in the fact that the only bad gorge on the north side could be easily turned by climbing over the broad low saddle of the Lenzer Heide. The track over the Alpine crest constructed in A.D. 1390 still exists, and in its present ruinous condition provides one of the most objectionable paths for foot-goers in my knowledge. The reason for its disuse is that when carriage roads were called for the Julier, a pass known but apparently little used in Roman times, was preferred. It fulfilled a double purpose as a means of access to the Engadine and as a road to Italy, for in the absence of any ascent on the north side of the Maloja the Upper Engadine serves simply as a landing halfway down the stairs to Lago di Como.

The Maloja, I may note here, is interesting geographically (or morphologically as the scientists say) as the best instance of what a recent German writer calls a valley-pass penetrating the entire chain. The great longitudinal valley of the Inn is continued by the much lower trench of the Bregaglia and separated from it by nothing but a grassy bank. The nearest approach to this feature in the Alpine watershed is the mound in the Pusterthal which divides the headwaters of the Adige and the Drave.

In the Middle Ages the Julier was used mostly as a through route in connection with the Bernina and the passes of the Bergamasque Alps, of which the chief were the Passo di San Marco and the Aprica. These,

THE LOWER STEP ON THE SAN BERNARDINO PASS

THE RHONE GLACIER RETREATING UP ITS STEP

LAGO NERO AND LAGO BIANCO. SUMMIT OF THE BERNINA PASS

when the Spaniards occupied the Milanese and had a castle at the head of the Lago di Como, enabled travellers to avoid their dominions and "pop up," as Lassels says, at Brescia.

In the east of Graubünden, in the Livigno district, there are quite a number of passes which I must leave out of consideration, though some of them are not unknown in military history. They cross relatively low grassy ridges, but are defended by intricate valleys and gorges.

The next important pass is the Umbrail Pass or Wormser Joch. It was frequently used during the great days of Milan in the sixteenth century by princes and merchants. It was the direct route from Tyrol by the Inn Valley and the Vintschgau to the Lago di Como by the Val Tellina. It was only in A.D. 1820 that it was superseded by the 800 feet higher and adjacent Stelvio. At that date the Austrians wanted a direct military access to the Milanese, and, since Switzerland owned the Münster Valley north of the Wormser Joch, had to take their road over a loftier ridge, the highest carriage pass in the Alps, 9055 feet. When you read in historical works of the passage of the Stelvio in early times you may as a rule take it that the Umbrail Pass is intended.

Here I touch on the limits of the Austro-Italian frontier.

Let me refer in conclusion to what seems to me one of the main features in the story of the Passes. In the beginning they were few and far between, but as Roman roads decayed and the empire broke up, as frontiers and custom duties and road dues multiplied, and greedy nobles and bishops exacted tolls, they became more numerous. Merchants looked out for the cheapest and safest, and not necessarily the shortest road. When all tracks were bad there was not so much to choose between. But when roads for wheels were once established, traffic again became concentrated, so that you find the carriage roads of the nineteenth century practically reviving the Strata Romana of the first century.

And what about the twentieth century? I confess I have felt a certain sadness in preparing these few and imperfect notes, which in no sense pretend to be a history of the Passes.* For to write of the Alpine Passes seems, as it were, to compose an obituary notice. Will they soon be no more, superseded by horrid, if convenient, tunnels? The old diligences are being taken off. No more, as a rhymer has it:—

> "No more the jangling post-chaise plies
> Across St. Gotthard's frozen ridge;
> The De'il grown older, grows more wise,
> He burrows where he built a bridge."

No longer shall we climb slowly among the pines and waterfalls into the keen mountain air, then plunge down the long zigzags to the chestnuts and the trellised vines and the campanili and the little untidy brown towns

* For fuller details I would refer the English reader to the works of that indefatigable student of Alpine history, Mr. W. A. B. Coolidge. See in particular 'The Alps in Nature and History.' Methuen. 1908.

every stone of which speaks and smells of Italy. We shall be carried like sardines in a box from one Palace Hotel to another. A single lifetime has done it. I can remember sixty years ago, when a dozen diligences started from in front of "The Three Kings" at Basle. Then for a generation we lost the approach to the Alps, the wonderful vision of the snows from the Jura. But time brings for the aged its revenges and compensations. One of the chief of them is the motor. It encourages us not only to revisit the Alpine Passes, but to approach them, as our ancestors did, through the stately avenues and vineclad hills of Central France and the idyllic landscapes and flower-decked townlets of the Swiss lowlands.

After the President read the paper a discussion followed.

Prof. GARWOOD: The President has asked me to say something about the physical features of the passes he has described to us. I am afraid it is too late to attempt this evening to discuss at all fully so large a subject, but I may perhaps call your attention to one or two of the more striking features which are characteristic of the passes of the central chain of the Alps. You will have noticed in the photographs shown on the screen the marked difference in character between the northern and southern sides of the passes near their summits, notably in the St. Gotthard, the Splügen, the Maloja, and the Bernina. You will have been struck by those wonderful roads streaming like twisted ribbons down the sides of the deeply cut valleys on the southern side, while on the northern slopes the roads are content to follow the river-banks with scarce ever a bend. If we take our stand on a prominent point on the crest of the range, as for instance the summit of the Monte della Disgrazzia, and look down along the water-parting, we are at once struck by the fact that whereas the northern side forms a gently sloping plateau covered with *névé* and glacier systems tucked in along the southern flank of the Engadine, the southern side of the range falls steeply in rocky terraces and grassy slopes practically free from permanent snow and ice. This contrast is due directly to the greater height of the snow-line on the south side of the range, in consequence of which that side is exposed to a greater extent to the denuding action of frost, rain, and running water; while the northern side is protected by its covering of ice and snow. As a result of this, the crest of the range is slowly but surely receding northwards and encroaching on Swiss territory; and what applies to the range as a whole applies still more to the valleys at the head of which lie the passes, our special concern this evening.

Our President emphasized the importance of the natural obstacle formed by the gorge. These gorges are undoubtedly due to running water and result from the action of rivers sawing down into the floors of older and much wider valleys. Fragments of these older valley floors are frequently seen jutting out above the gorges and forming isolated grazing-grounds, the true "Alps." If we examine the profile of one of the main Alpine valleys, as for instance the Chamonix Valley, we can trace the remains of similar benches at still higher levels which are often rendered conspicuous by groups of châlets. These are the relics of still older valley floors. The Swiss geologists tell us that there were three interglacial periods separating the different stages of the great glacial period, and during each of these the rivers must have been at work cutting down into the floors of the valleys which had been widened and straightened by the glaciers that filled the valleys during the preceding cold period. It must be remembered

that during these interglacial periods the rivers would be immensely powerful and capable of great erosive work, for, in addition to the water derived from the rainfall of the period, they would also draw on a considerable quantity of the moisture precipitated during the preceding cold period and stored up in the snowfields and glaciers, which, as at the present day, would contribute a constant supply of water during the summer months. We should then expect the valleys to be greatly deepened during these interglacial periods, while, during the succeeding cold period, the gorges so formed would be widened and modified by glacial action. The formation of these gorges would not however be entirely confined to the ice-free periods, but would be initiated at an earlier stage by the rivers flowing under the ice; for a river would always tend to adjust itself to the level of the main valley of which it formed a tributary, while the overlying ice would work independently; the Via Mala, for instance, of which we saw pictures to-night, may well owe its origin to this process.

The President asked me to explain a photograph that was thrown on the screen to illustrate the route over the San Bernardino. It showed a wall of rock stretching right across the sky-line. This is the uppermost of three rocky "steps," *i.e.* sudden descents in the floor of the valley, which occur on the south side of the pass. This particular step, which is by far the deepest of the three, gives rise to the splendid falls of the M[illegible]o, a magnificent series of cascades totalling over 800 feet in height. The pi[illegible]pitous wall over which the water tumbles forms a great natural barrier right across the valley, which the present road is only able to surmount by leaving the main valley and travelling up a tributary glen making use of a great landslip which has fallen across the foot of the wall, and afterwards climbing back over a low spur into the upper portion of the main valley above the fall. These steps are frequently met within the upper portions of the main Alpine valleys and appear to be typically three in number. The Tosa fall on the south side of the Gries Pass, a photograph of which was thrown on the screen, affords another example. I have suggested in a paper read before this Society (*Geographical Journal*, September 1910, **37**, 310) that these steps indicate the positions to which the main glaciers retreated during the three interglacial periods; above these levels the valley floors would be protected to a great extent by the ice, while lower down rivers were cutting gorges, as described above. On the north side of the range the upper step is, in many districts, still covered by a glacier, thus giving rise to an icefall; the Rhone glacier is a good example. During recent years this glacier has been slowly retreating and is beginning to expose the underlying rocky step. The Mer-de-Glace is another instance. These upper steps were probably formed during the first interglacial period, while the middle and lower steps were formed during the second and third interglacial periods respectively. The upper step has been covered and protected by a glacier ever since the advance of the ice at the close of the first interglacial period. There is one other feature which I should like just to touch on before I sit down, namely, the little lakes which you have seen in many of the views taken near the summits of the passes. When I was a boy I was in the habit every summer of crossing over one or other of the passes leading to Italy, and I well remember looking forward to lunching at the hospices near the tops of the passes, because I knew that trout would probably be included in the bill of fare. My attention was thus called at an early period to the presence of tarns near the summits of the passes, and I remember being told that they were made by the monks who lived in the monasteries on the passes, in order that they might have fish on Fridays. It was not till many years later that my attention was again called to these tarns, and I realized

that the lakes were probably there before the monks and may in many cases have influenced the monks, and later the innkeepers, in selecting these sites for the hospices. The lakes are indeed another indication that the swiftly flowing rivers, draining the steep south side of the Alps, are steadily cutting their way back into the original crest of the range and stealing the tributaries of their northern neighbours. This is what is known as the "Law of Unequal Slopes." In time the rivers on the north side, deprived of their headwaters, are no longer able to scour out their channels, with the result that the *débris* brought down by the first lateral tributary is deposited across the floor of the beheaded valley and may accumulate there so that a lake is formed above it by the pounded surface drainage. Striking examples of lakes formed in this way are seen in the Engadine, at the head of the Inn Valley, where the Sils Lake occurs at the top of the Maloja Pass and the Lago Bianco and the Lago Nero at the top of the Bernina. In both these cases the headwaters of the Inn have been stolen by tributaries of the Adda, truncating the upper branches of the Inn Valley and leaving them projecting in mid air. A traveller ascending either of these branches in foggy weather might easily be precipitated down the cliffs which form the southern sides of one of these passes without knowing that he had yet reached its summit; indeed the Lago Bianco, which lies in the floor of the Inn valley, actually drains over the lip of the pass into the Poschiavo Valley, so that at the present day the water-parting between the Danube and the Po consists merely of the low ridge of the delta deposit which stretches across the Inn Valley between the Lago Nero and the Lago Bianco.

Sir MARTIN CONWAY: I do not profess to be an authority on the passes which the President has described to us to-night, especially those between Italy and France. The best way to become an authority on them is to get involved in an argument as to where Hannibal crossed the Alps, an occupation which I have always avoided. Our President has been up to the neck in it over and over again, and the result is the extraordinary knowledge he possesses of those low passes between France and Italy. When you get further round eastward a fine source of information is an argument with regard to the Saracens in the Alps; he has also been up to the neck in that. Thus he has become very well informed about the ancient history and geographical position of the various passes he has described to us. I was much pleased to see a photograph on the screen of an old woodcut which he told us represented pilgrims on their way to Rome. One of them was returning from Rome; the other from Santiago di Compostella, as the signs in their hats showed. We heard a good deal about the Simplon Pass, and many of us know the wonderful road over it. There is also a neighbouring pass to the east called the Albrun, which by misfortune rather than any intention I happened on one occasion to wander over; I then learned that it had been an even chance whether the road which now goes over the Simplon should have gone over the Albrun, the reasons in favour of the one or the other being about equally good. There are the remains of an ancient paved track over the Albrun, showing that it was much frequented at some early date. The Simplon is not the only pass which owes its fame to luck, and might have been replaced by a neighbour of insignificant reputation. The Albrun is only a single case in point. The President referred to the Abbey of St. Maurice in connection with the pass of the Great St. Bernard; he said that the way through St. Maurice was a favourite pass of Charlemagne and the Carlovingian Emperors. If you ever chance to be going along that road I would advise you to stop at St. Maurice, ring the bell of the Abbey, and ask to be shown the Treasure, because the treasure of St. Maurice d'Agaune is the

finest collection of magnificent golden and other ornaments of early date that exists anywhere in Europe. In it you will find offerings from various great personages of the past, almost every one of which commemorates the passage over the Great St. Bernard of some considerable individual. You will find, for instance, the golden jug which Charlemagne himself presented; you will find a little almond-shaped crystal object set in gold, which is the reliquary locket that St. Louis used to wear round his own neck, and which he gave, with a vellum charter authenticating the gift, to the Abbot of St. Maurice. The vellum with the signature of St. Louis is still there. You will also find several other most wonderful treasures in the Abbey of St, Maurice, and every one of them is there because of the pass of Great St. Bernard which lies behind.

Sir HENRY HOWORTH: I wonder, sir, if you will allow me, not to make any comments on your paper, but to make a small request. I wish very much that some time you would favour us by writing a real monograph on the Alpine Passes, and I should like you in doing so to carry the story of those passes a little further back in time. One notable thing about the passes has been that while the western were mere tracks until Pompey and Augustus and his two step-sons, Tiberius and Drusus, intervened, and Claudius made the great Claudian road, the eastern passes, on the other hand, must have had roads along which not merely small bodies of troops could go, but along which great invading hosts with their families could easily pass, and there must therefore have been excellent roads there long before the Romans crossed the Alps. We must remember one great fact with regard to at least two of these mountain passes: the one that led to Hallstadt and thence into Southern Hungary; and the other that went to the Lake of Constance and then on to the Rhone on one hand and the Baltic on the other. The latter road is marked by the graves of merchants who went to and fro between the Baltic and Italy at a time when there was a great trade between them in amber, which is found in quantities in the graves of Villanova and elsewhere in Italy. The like presence of amber marks a whole series of graves from Pomerania right down to Constance; alongside of them are another set of graves, perfectly contemporary, which contain no amber, but bronze objects, most of them Etruscan, or belonging to the first iron age, left by men going north. This shows that at least as early as the first iron period there was a great trade route by which the amber of the Baltic was exchanged for bronze. It must have crossed the Alps between Lake Constance and Lakes Como and Maggiore. Further east, and starting from Aquilea, was another early mountain road, which presents a similar and perhaps more interesting problem: the great road that led to the salt-mines of Hallstadt, which supplied all northern Italy and a great deal of Germany. On this road have been found the finest graves and most extraordinary objects of the earliest age. Here you have a proof that long before the Romans knew the Alps you must have had across these eastern passes roads quite capable of accommodating large bodies of merchants; and not only merchants but other invaders. The Gauls, I feel sure, came this way, and the Brenner Pass is called after their chief Brennus. So also came their successors, the Goths and the Lombards, all of them taking their families and impedimenta with them.

I wish to express my thanks to my very old friend for having sketched so admirably the story of these passes. May we hope for a substantial work on the subject relieved, as it has been to-day, with picturesque phrases. As an old parson once said to me, "I like a man who puts an occasional stained glass window into his sermons," and we had a good many of them to-night.

The PRESIDENT: I am sure that you will be grateful if I now wind up the discussion. My remarks will be very brief. I listened with respect to Prof. Garwood's very luminous summary of the natural forces which have helped to make the Alps. He spoke of the work of the sub-glacial torrents. We have an excellent opportunity of observing that in the glacier that comes down below the Eiger close to the inn on the Little Scheideck. The glacier has retreated about half a mile, and we see in the ground it has abandoned smooth rocks, and in their middle a deep cleft, cut as if with a knife. The Lower Grindelwald glacier affords another excellent example of similar action, where the contrast between the work of ice and water is forcibly shown.

My friend Sir Martin Conway has been pleased to make sundry genial gibes; but I noticed that while he was talking of Hannibal and the Saracens the real point of his remarks was revealed by one word. He talked of the *low* passes I had been describing. Sir Martin Conway is, as we all know, a great mountaineer, and he naturally despises a pass that has not a glacier on the top of it.

Sir Henry Howorth has addressed a challenge to me to which I am thankful to say that I can give an amply sufficient reply. The task of writing the history of the Alpine Passes has been undertaken by the man in Europe who is most competent to do it, and that is Mr. Coolidge. He has begun with an article in the *English Historical Review* on the first Pass, the Col di Tenda. I understand he is going right through the Alps, and if he does the rest with the same marvellous industry and almost profligate detail he has bestowed on his first article, there will be nothing left for future writers to do. I think it would be a grave impertinence for anybody to try to rival him, and it is certainly far from my intention to make the attempt.

There is only one remark made by Sir Henry Howorth which I should like to qualify. There is no doubt that the passes which were used in early times were both the western and the eastern passes. I am quite ready to give precedence, in the number of peoples who went over them, to the eastern, but I believe that most of the Gauls came over the western. If Sir Henry Howorth refers to Livy he will find a very decisive statement that the Gauls came over the western passes. They were able to show Hannibal the way through the Alps, and they would not have been able to do so if they had not been in the habit of traversing them. I thank those who have taken part in this debate for so kindly enlivening our meeting.

A CONSIDERATION OF THE POSSIBILITY OF ASCENDING THE LOFTIER HIMALAYA

A. M. Kellas

Read at the Afternoon Meeting of the Society, 18 *May* 1916.

UNDER certain conditions mountaineering can be regarded as a branch of geographical exploration. Any one doubting this statement has merely to read a recent publication of the Indian Survey, describing the completion of the "Link connecting the Triangulations of India and Russia," to be convinced of its truth.

Surveys involving the triangulation of the great ranges of Asia and America, still far from complete, will require mountaineers to carry them out, using the term "mountaineer" in its truest and widest signification,

namely, that mountaineers are those who can ascend and find their way among mountains. If this fact had been grasped when the survey of the Himalaya was begun about seventy years ago, and surveyors specially trained as mountaineers, the maps of the mountain regions would have been more accurate and complete. Amateur geographers will probably, however, find the correction of the present maps of great interest, and the above statement is not intended either as complaint or protest.

Although, fortunately for our surveyors, it is not absolutely necessary to ascend mountains above 25,000 feet in triangulating the Himalaya, still, such ascents would be of scientific importance, and therefore a consideration of the difficulties involved in climbing the loftier summits comes within the purview of this Society. Geodetic problems, such as the exact determination of the effects of refraction on altitude calculations, might be solved, triangles with immense length of side directly measured, physiological problems of considerable interest worked out experimentally, and Science as a whole would undoubtedly benefit. If these reasons were deemed insufficient, one might bring forward the primeval axiom which subconsciously at least is in the soul of every geographical explorer: Man must conquer and investigate every spot on the Earth's surface. If the difficulties are carefully considered the conquest should be peaceful; but Nature in some of her aspects is adamantine, and even the most cautious explorer may suffer.

From the general point of view, the chief difficulties of Himalayan exploration might be summarized as due, firstly, to transport, and, secondly, to intrinsic difficulties of the mountain region.

Transport cannot be discussed in a paper of this type, but a few notes might prove useful. The actual difficulties vary with the region to be explored. As all tents, equipment, foodstuffs, etc., have generally to be carried 100 to 200 miles, the arrangement of carriage, or "bandobast" as it is termed, is of great importance in connection with the success of an expedition, especially if time be limited. All luggage will have to be carried by coolies, if ponies, mules, or yaks are not available, or the route too rough for animals. The experienced traveller will generally use animals for a portion of the journey, if procurable, in order to save time. After reaching the glaciers one has generally to depend upon coolie transport.

Of the different types of coolie, the writer has found the Bhutia Nepalese superior to all others he has employed. They are strong, good-natured if fairly treated, and as they are Buddhists there is no difficulty about special foodstuffs, a point strongly in their favour at high altitudes. The Lepcha and Kumaoni are of inferior physique, but the former makes an excellent coolie. The Kashmiri of the plains were not found reliable on the mountains, which was perhaps hardly to be expected; but the hillmen of North-West Kashmir can be trained, as Collie's account of mountaineering in the Nanga Parbat region shows and the author can confirm. The

Gahrwali is inferior to the Bhutia at high altitudes, because he is a Hindu, and there is far more difficulty with his food supply.

The writer has had no opportunity of travelling with the Gurkha and Balti, who are highly spoken of by those competent to form an opinion. A solitary traveller, anxious to do a little easy climbing, might find it worth his while to take a few carefully selected Bhutia Nepalese with him as personal servants to any mountain region. They can be engaged at Darjeeling.

The first difficulties in the mountain region would be among the glaciers leading to the peaks to be attempted. The Himalayan glaciers may be divided into two main types: (*a*) Great moraine-covered ice-streams, like the Zemu and Kangchenjunga Glaciers, with ice-cliffs and small tarns. The ice-cliffs have resulted from the opening out of the crevasses. The great glaciers of the Mount Everest region seem to be of this type, as the slide showing the north-east Chomo Langmo Glacier indicates. This glacier seems to be covered with limestone *débris*, which is of great geological interest. These glaciers are troublesome, but offer no serious difficulties with regard to transport. Roping is unnecessary. (*b*) The tributaries of this type, and sometimes their upper portions, are like the ordinary Alpine glaciers, and crevasses, icefalls, etc., are often difficult and dangerous for loaded coolies. Before the monsoon snows set in seriously one has to be particularly careful. Coolies often dislike roping, and may shirk it if not carefully looked after. A case in point, where a fatal accident nearly occurred, was emphasized in an earlier paper in the *Alpine Journal*.

After these preliminary notes, we now come to the consideration of the possibility of ascending the loftier peaks of the Himalaya, mountains over 25,000 feet in altitude, none of which have so far been climbed. We will consider the limiting case as a rule, and the problem might be stated as follows:—

Could a man in first-rate training ascend to the summit of Mount Everest (Tibetan Chomo Langmo), 29,141 feet above sea-level, without adventitious aids?

Colonel Burrard's corrected values are used for the loftier peaks, as 140 feet might require at very high altitudes an hour's climbing, which could easily mean the difference between success and failure.

The difficulties of ascending the higher Himalaya must be considered from two points of view: I. Physiological; II. Physical.

I. Physiological Difficulties.

The physiological difficulties are indubitably of a very high order, and depend upon deficiency of oxygen. The supply of oxygen varies directly with the barometric pressure. At sea-level the pressure of the atmosphere is balanced by a column of mercury 760 millimetres high, but at the top of Mount Everest the barometric pressure would be about 250 mm., and the oxygen supply would therefore be only one-third of that at sea-level.

KANGCHENJUNGA FROM A DISTANCE OF 9 MILES AT A HEIGHT OF 18,000 FEET ON A SOUTHERN SPUR OF THE JONGSONG PEAK, NEPAL

KAMET FROM NEAR THE SUMMIT OF DHANARAU MOUNTAIN, GARHWAL (18,500 FEET), EIGHT MILES TO THE NORTH-WEST

The body is kept alive by the process of respiration, during which oxygen taken up by the blood from the air in the ultimate ramifications of the lungs—the alveoli—passes with the blood to the tissues, effecting oxidation processes necessary during maintenance of life. Carbon dioxide is formed, and being transported by the blood to the lungs is exhaled.

How absolutely fundamental respiration is in maintaining life may be grasped when it is stated that unconsciousness would ensue in about three-quarters of a minute if an indifferent gas like pure nitrogen is breathed, the body being at rest. Death would follow in a few minutes unless oxygen were supplied.

One has to consider whether respiration near the summit of Mount Everest under about one-third of an atmosphere pressure will suffice to aërate the blood not only at rest, but while climbing. The problem might be attacked by the four following methods :—

I. By consideration of the physiological effects recorded during high balloon ascents.

II. By consideration of the results obtained in air-chambers at sub-atmospheric oxygen pressures.

III. By evaluation of observations and experiments of physiologists at sea-level and moderate altitudes—up to 15,000 feet.

IV. By consideration of the effects of minor Himalayan ascents up to the highest recorded, viz. 24,600 feet.

Space permits only of a consideration of the first three methods, as the fourth would involve a discussion of mountain sickness and the limits of acclimatization to high altitudes.

I. *Balloon Ascents.*—From our point of view two are of special importance, namely, that of Glaisher and Coxwell from Wolverhampton in 1862, and that of Tissandier and two companions (Crocé-Spinelli and Sivel) from Paris in 1875.

In Glaisher and Coxwell's ascent at 29,000 feet both men became paralyzed, and then Glaisher became insensible. Coxwell, unable to raise his hands, seized the valve-rope in his teeth, managing to open the valve before he in turn lost consciousness. Fortunately Coxwell's action gradually stopped the ascent of the balloon, thus undoubtedly saving their lives. Glaisher claimed that the balloon rose to 37,000 feet before beginning to descend. If so this would constitute a record ascent; but the estimation of height seems of doubtful accuracy.

Tissandier's ascent to 27,950 feet was not so fortunate. Although provided with oxygen the three men were paralyzed before they could raise the tubes of the oxygen reservoirs to their lips. Tissandier fainted at an altitude of 26,500 feet (approx.), and when he recovered consciousness his two companions were dead and the balloon was rapidly descending.

The conclusion from these balloon ascents must inevitably be that an ascent of Mount Everest without adventitious aids would be quite impossible if the physiological conditions of mountaineers and balloonists

are comparable. They are not comparable, however, as the balloonist has no opportunity of becoming acclimatized to high altitudes. As will be shown later, this fact is of fundamental importance.

In many more recent balloon ascents oxygen has been used with success. In 1898 Berson and Spencer ascended from London to 27,500 feet, and in 1901 Berson and Süring ascended from Berlin to about 35,500 feet, an actual barometric reading corresponding to 34,500 feet being made before both men, notwithstanding oxygen inhalations, became unconscious.

These ascents showed that oxygen was an immense help at high altitudes, and might suggest that the ascent of Mount Everest would be possible if air enriched with oxygen were breathed during the latter portion of the climb.

II. *Experiments in Air Chambers.*—Considering pressure alone it might at the outset be stated that considerable variations of pressure, *e.g.* increase up to four atmospheres pressure or diminution to a pressure of a fourth of an atmosphere hardly affect the body. Provided decompression is slow, one might say that moderate variations of pressure are innocuous. It is alteration of the available amount of oxygen which affects the body, and this alone need be considered. Two types of experiments are worth studying.

1. Experiments in which the oxygen percentage in the air breathed was *slowly* reduced. Rapid variations need not be discussed as they are inapplicable.

2. Experiments in which the pressure of the air breathed was diminished.

Both yield similar results.

1. *Slow Alteration of Percentage of Oxygen in the Air breathed.*—When the percentage of oxygen in the inspired air is slowly reduced below 20·96 per cent., the proportion present in air at sea-level, no effect is produced until the percentage is 12 to 14, and then the breathing becomes deeper (*i.e.* more air is taken into the lungs than normal), and at 10 per cent. cyanosis is evident, the lips, ears, etc., being blue. Haldane states that "marked symptoms of mental incapacity are also present. Simple observations or calculations become impossible." Consciousness is generally lost without a struggle when the percentage of oxygen in the air breathed falls to between 10 and 7 per cent.

2. Experiments in air-chambers where the atmospheric pressure was diminished gave exactly similar results. Mosso, for example, lowered the pressure in an air-chamber to 310 mm., corresponding to 24,500 feet at 15° C. "His mental faculties became blunted, he experienced difficulty in reading his watch, was twice unable to count his pulse, his handwriting altered and his memory weakened."

In considering the results of experiments in air-chambers Starling states that the lowest limit at which life is possible corresponds to an

oxygen tension in the alveoli of 27 to 30 mm., which is distinctly above that calculated for Mount Everest.

It follows, therefore, from experiments in air-chambers that the ascent of Mount Everest should be quite impossible without adventitious aids, agreeing with the observations of balloonists. Again however the conditions are not comparable, since the subject in an air chamber cannot become acclimatized to low oxygen pressures, whereas the mountaineer can.

Mixing oxygen with the air in the chamber gives significantly a different result. In air enriched with oxygen Paul Bert withstood successfully a pressure of 240 mm., which corresponds to nearly 32,000 feet. The best results were obtained with a mixture of oxygen and carbon dioxide. Aggazotti actually breathed such a mixture at a pressure of 120 mm. for some time. This pressure corresponds to approximately 50,000 feet above sea-level.

These experiments prove conclusively that air enriched with oxygen would easily maintain life during rest or moderate work at the summit of Mount Everest, where the pressure is, approximately, one-third of an atmosphere.

III. *Consideration of Observations and Experiments of Physiologists at Sea-level and Moderate Altitudes up to* 15,000 *feet.*—The work done by Haldane and by Barcroft and their respective coadjutors is of special importance. A very interesting series of observations on the incidence of mountain sickness was made by Haldane and his co-workers on the summit of Pike's Peak, Colorado, in 1911. Pike's Peak is one of the eastern Rocky Mountains near Denver, which has a cogwheel railway to its summit (14,109 feet), upon which there is a small hotel. The following notes on the effect of change of altitude on the visitors to the summit show that mountain sickness was of very frequent occurrence.

"Among the numerous visitors who came up by train and stayed only about three-quarters of an hour, the most marked and almost universal symptom was blueness of the lips, cheeks, etc., accompanied by great hyperpnœa (*i.e.* deep breathing) on exertion. As a rule there was no marked discomfort, but some persons became very miserable and faint, and actual fainting was observed occasionally, as well as vomiting. One press representative who came to 'interview' us became so alarmingly blue and faint that we gave him oxygen, which revived him at once, and immediately restored his colour and spirits. He continued all right for a few minutes, and then again became blue and faint, and was again revived by oxygen, after which he hurried into a descending train.

"Among those who walked up or came on donkeys, the symptoms were much more general and severe. The blueness was more marked, and nausea, vomiting, headache, and fainting were extremely common. Many persons walked or rode up during the night to see the sunrise, especially on Sunday morning, and the scene in the restaurant and on the platform

outside can only be likened to that on the deck or in the cabin of a cross-channel steamer during rough weather." And this occurred at 14,100 feet!

The description suggests that if any of the Himalayan giants in the far future are desecrated by a cogwheel railway, oxygen will have to be breathed continuously by the patrons when near the summit, otherwise none will get down alive. This may be a consolatory thought to some minds.

Haldane's party suffered somewhat on first arrival, but after a few days on the summit, blueness, headache, nausea, and lack of appetite vanished, and in about a week all felt quite well physically and mentally. With regard to the mental effect, it must be noted, however, that the brain seems particularly sensitive to a deficiency of oxygen. Many visitors were inclined to be unreasonable, the symptoms being similar to those of alcoholic poisoning, and a deputy-sheriff is therefore stationed at Summit House during the summer.

This psychic effect is apparently not confined to those unacclimatized to altitude. Miss Fitzgerald, one of Haldane's collaborators, who independently carried out observations at many high mining camps in Colorado, states that the nervousness of the people, both men and women, was very apparent, especially above 7000 feet, and adds: "The miners and others were fully conscious of the nervous tension, and attributed to this impulsive actions mentioned as common in mining communities at these altitudes." It might follow that some of the regrettable incidents with revolvers in the old days might belong to this category, but statistics and more extended observations are required. The Tibetans do not seem to be affected with nervousness.

The above account shows that mountain sickness is apparently something very real in the case of people unacclimatized to high altitudes when pressure is rapidly varied. In the Alps one rarely notices serious cases because of adaptation, and in the Himalaya, where as a rule the ascent to 15,000 feet is gradual and requires at least a week's travel, mountain sickness is exceptional even at high altitudes.

Paul Bert indicated, in 1878, that the cause of such mountain sickness was simply want of oxygen. He carried out numerous experiments with men and animals under different pressures, and using various mixtures of oxygen, nitrogen, and other gases. He showed that symptoms similar to mountain sickness were produced when the oxygen partial pressure of the mixture fell below a certain value. Bert's explanation has been challenged. Mosso maintained that many symptoms of mountain sickness depended on deficiency of carbon dioxide, which he termed "acapnia," and Kronecker suggested mechanical reasons. Recent experiments of Zuntz, Haldane, Barcroft, and their co-workers have clearly indicated that Bert was correct, and one might therefore state that *mountain sickness depends primarily upon deficient oxygen supply*. There may be many accessory factors, but the fundamental cause underlying all is *want of oxygen*.

As already stated, Haldane's party on Pike's Peak (14,109 feet) became completely acclimatized after about a week's residence on the summit, and the problem which really has to be solved in connection with Mount Everest might now be stated as follows: Is it possible to become sufficiently acclimatized to altitudes of 24,000 feet to 25,000 feet to enable one to climb to over 29,000 feet? This question can only be answered after a careful study of the scientific explanation of acclimatization to moderate altitudes which has been worked out by Barcroft and Haldane and their respective co-workers.

In order to be able to understand this explanation, one must, as a preliminary, study more closely what takes place during respiration. The process of respiration includes the formation of a compound of oxygen and hæmoglobin called oxy-hæmoglobin, which, being carried to the tissues, gives up its oxygen, thus maintaining life, which as previously mentioned depends on the continuity of a series of slow oxidation reactions. The two processes mentioned might be represented as a reversible chemical equation—

$$Hb + O_2 \gtrless HbO_2$$

In the lungs, under an oxygen pressure which varies with the altitude, oxy-hæmoglobin is formed, and in the tissues, where the oxygen pressure is less, oxygen is given up to oxidizable substances.

It is obvious that a study of the pressure conditions under which hæmoglobin respectively takes up and gives off oxygen, might help one to understand the physiological difficulties of respiration at high altitudes.

Experiments were carried out by Hüfner with *hæmoglobin dissolved in water* at blood temperature (37° C.) and a varying pressure of oxygen, with the following result:—

TABLE I.

Pressure of oxygen in millimetres of mercury.	Percentage saturation of the hæmoglobin with oxygen.
10	50
20	71
30	81
40	87
50	90
60	92
70	93
80	94-5
90	95
100	96

To enable these values to be thoroughly understood, consider one pressure, *e.g.* 50 mm. If a large quantity of air containing oxygen of partial pressure 50 mm. is shaken with a small quantity of hæmoglobin dissolved in water, the hæmoglobin rapidly takes up oxygen until 90 per cent.

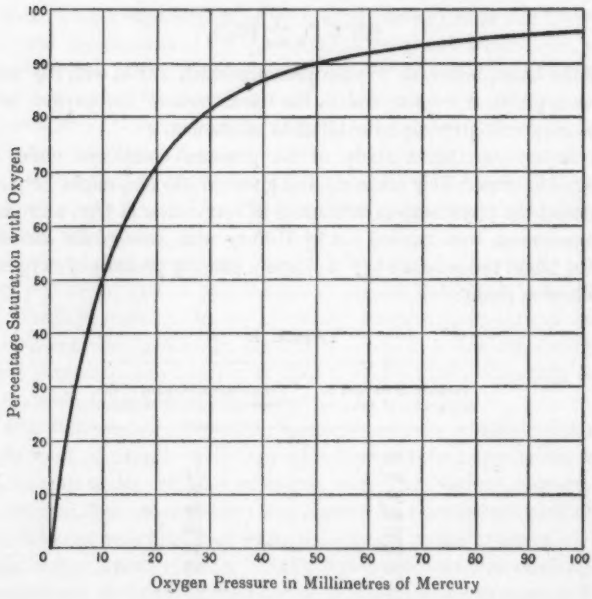
is saturated, *i.e.* there must be in the water 90 per cent. oxy-hæmoglobin and 10 per cent. hæmoglobin. If the oxygen pressure is increased, more oxygen will be taken up; but if diminished, oxygen is given up, *e.g.* if the pressure of the oxygen were diminished to 10 mm., oxygen would be given up until 50 per cent. of the hæmoglobin remained as oxy-hæmoglobin.

The connection between the hæmoglobin in water and the oxygen pressure is best represented, not by the above set of figures, but by a curve which shows graphically the relationship between the two inter-related qualities.

Plotting the pressure of oxygen in millimetres of mercury horizontally (along the abscissa) and the percentage saturation of hæmoglobin in water vertically (along the ordinate), one obtains what is termed the *dissociation curve of oxy-hæmoglobin in water.*

CURVE No. 1.

Dissociation Curve of Oxy-Hæmoglobin dissolved in Water at 37° C. (Blood Temperature)



This dissociation curve, worked out by Hüfner, somewhat puzzled physiologists, because even at comparatively low pressures the hæmoglobin is nearly saturated with oxygen. For example, the alveolar oxygen pressure in the lungs at the top of Mont Blanc (15,780 feet) should be nearly 50 mm., corresponding to 90 per cent. saturation, and at sea-level the oxygen pressure is about 100 mm., corresponding to a saturation of 96.

The trifling difference of 6 per cent. in saturation for an alteration of altitude of nearly 16,000 feet should not cause serious effects, and Bert's explanation that oxygen deficiency was the exciting cause of mountain sickness seemed unintelligible.

The difference was explained when it was discovered that the dissociation curve of hæmoglobin in blood is quite different from that of hæmoglobin in water. Many factors affect the action of oxygen on hæmoglobin, notably, (1) temperature, (2) presence of carbon dioxide (an acidic body), (3) presence of other acidic bodies like lactic acid, (4) presence of salts.

With regard to temperature, it is obviously only profitable to consider one temperature, viz. 37° C. (99° F.), the normal blood temperature.

The substances mentioned, carbon dioxide, other acidic substances, and salts are present in blood, and tend to flatten the dissociation curve of hæmoglobin. The normal dissociation curve of hæmoglobin in blood can be drawn from the following experimental data, the pressure of CO_2 being taken as 40 mm., the normal pressure at sea-level.

TABLE II.

Oxygen pressure in millimetres of mercury.	Percentage saturation of hæmoglobin in blood with oxygen.
10	10
20	32
30	57
40	74
50	84
60	90
70	92
80	93·5
90	95
100	96

These results can be expressed by a curve, the *dissociation curve of hæmoglobin in blood.* (See next page.)

This normal dissociation curve for hæmoglobin in blood is, as already remarked, flatter than that for hæmoglobin in water, with the result that the hæmoglobin is less saturated for any given pressure of oxygen. For example, the saturation of hæmoglobin in water with oxygen at 24 mm. oxygen pressure—the calculated approximate alveolar pressure for the top of Mount Everest—would be 74 per cent., whereas the saturation of hæmoglobin in blood with oxygen at the same pressure would be only about 40 per cent.

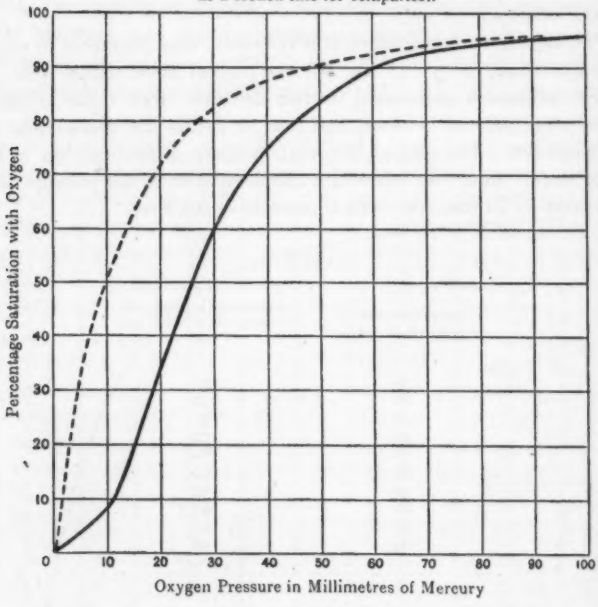
One of the main factors causing flattening of the dissociation curve is carbon dioxide, and as the quantity of this substance in blood considerably diminishes with altitude, one might suppose that the curve would steepen, and that the blood hæmoglobin would therefore be more easily saturated

with oxygen. Barcroft, however, proved by experiments carried out on the peak of Teneriffe, that although the carbon dioxide in the blood diminishes with altitude, yet the resting dissociation curve for any individual was identical with his curve at sea-level.

CURVE No. 2.

Dissociation Curve of Oxy-Hæmoglobin in Blood at 37° C. (Blood Temperature)

The Dissociation Curve of Oxy-Hæmoglobin in Water is given as a broken line for comparison



This surprising fact was confirmed by Haldane on Pike's Peak, and the explanation was found by Barcroft to depend upon an increased acidity (or rather diminished alkalinity) of the blood in such quantity as to exactly compensate for the loss of carbon dioxide, which itself is acidic in character.

This relationship between carbon dioxide and blood acidity (or diminished alkalinity) is of far more vital importance than might at first sight appear. *The automatic regulation of the process of respiration* at sea-level depends upon the quantity of carbon dioxide in the blood, the pressure of which is the same as that in the alveoli of the lungs. The carbon dioxide in the blood effects the regulation by acting directly on a nerve-tract called the "respiratory centre" in the medulla oblongata, nerves from which control the muscles of respiration. Normally, about

eighteen respirations occur in a minute with the body quiescent. If work is done, more carbon dioxide is produced, the respiratory centre is more powerfully stimulated, and one breathes more deeply and rapidly, thus supplying that necessary extra oxygen to the tissues.

If, while at rest, one breathes rapidly for about a minute—forced breathing—so as to wash the carbon dioxide out of the blood, the respiratory centre ceases to be stimulated, and breathing stops until sufficient carbon dioxide is formed to act as excitant.

At high altitudes, as mentioned, the quantity of carbon dioxide in the blood diminishes, but the acidity increases correspondingly. This acidity acts on the respiratory centre in the same way as carbon dioxide.

It follows from above that there seems to be less danger than might have been expected of a cessation of respiration on breathing rapidly for some time at high altitudes. Even if all the carbon dioxide were washed out of the blood, the respiratory centre might still be sufficiently stimulated by the increased acidity of the blood circulating through it. This is of primary importance, as the following example will show.

If a subject in an air-chamber were decompressed to 370 mm., correspondlng to 20,000 feet, his oxygen supply would be diminished to less than half. Suppose he then carried out forced breathing so as to try to get a larger quantity of oxygen through his lungs per minute than at sea-level, he would quickly wash the carbon dioxide out of his blood, the respiratory centre would cease to be excited, he would stop breathing, and would probably faint because of deficient oxygen supply to the brain.

Were it not for the increased acidosis of the blood after acclimatization to high altitudes, the danger of fainting after rapid breathing during climbing might be a most serious one for the mountaineer. A climber fainting above 25,000 feet would obviously be in grave danger.

We are now in a position to grasp the significance of the different factors conditioning true acclimatization to moderate altitudes.

These factors are four in number, and might be briefly discussed in the following order. The third factor is at present debateable :—

1. The oxygen pressure in the alveolar air rises.
2. The number of red blood-corpuscles and the quantity of hæmoglobin in the blood increase in due proportion to each other.
3. There may be actual secretion of oxygen by the lung epithelium, so that the arterial oxygen pressure can be raised above that in the alveoli.
4. The blood stream may circulate more rapidly during exercise at high altitudes than at sea-level.

1. *Increase of Oxygen Pressure in the Alveolar Air.*—The increase of pressure of oxygen is brought about by a diminution of the alkalinity of the blood, which means that its carrying power for carbon dioxide diminishes. On staying for a few days at a moderate elevation the pressure of the alveolar carbon dioxide diminishes in accord with this

diminished carrying capacity, and as the partial pressure of carbon dioxide sinks that of oxygen rises. The respiratory centre remains adequately stimulated because of the increased acidity of the blood, The gain of alveolar oxygen pressure is considerable, as shown by the following table :—

TABLE III.

	Alveolar pressure of oxygen.	
	Calculated for 40 mm. CO_2 as at sea-level.	Observed.
Sea-level	102 (approx.)	102
10,000 feet	59	65
15,000 feet	38	52

Considering the calculated and observed pressures at 15,000 feet, one notes the great advantage of the extra 14 mm. pressure of oxygen. On referring to the dissociation curve of hæmoglobin in blood one sees that at 52 mm. oxygen pressure the blood would be about 80 per cent. saturated with oxygen, whereas at 38 mm. pressure it would only be about 65 per cent. saturated.

As stated, this adaptation to altitude may take a few days to develop, so that any one ascending quickly from sea-level to 15,000 feet is physiologically at a great disadvantage, as his carbon dioxide alveolar pressure will be nearly the same as at sea-level (40 mm.), and his oxygen pressure about 38 mm. This factor is obviously of considerable importance in connection with adaptation on the higher Himalaya, and a table will be given later to show the relationship between altitude and calculated alveolar oxygen pressure after acclimatization.

2. *Increase of Red Corpuscles and Hæmoglobin.*—It is generally stated that an increase in the number of red corpuscles and hæmoglobin occurs at high altitudes, but the exact value of this multiplication is not so simply gauged as has been supposed, and much more work must be carried out before its exact significance is understood. The normal number of red corpuscles for man is about 5,000,000 per cubic millimetre at sea-level, and values up to over 8,000,000 have been recorded at different altitudes. A few typical determinations might be quoted :—

TABLE IV.

	Metres.	Feet.	Red corpuscles.
Sea-level	0	0	5,000,000 (approx.)
Zurich	412	1,352	5,752,000
Davos Platz ...	1560	5,118	6,551,000
Pike's Peak	4300	14,109	7,000,000 (approx.)
Andes	4392	14,410	8,000,000
Taghdumbash Pamir	5548	18,203	8,320,000

These values seem easy of interpretation. To use a simile of Barcroft's, the number of "ships" available for carrying their precious cargo of oxygen to the tissues is increased, more oxygen cargoes will therefore be despatched in a given time from the lungs, and this may compensate for a diminution in weight of each freight carried.

If, however, the number of corpuscles increases quickly simultaneously with a rapid alteration in altitude, it is almost certain that the blood merely concentrates itself by transudation of part of its plasma (in which the corpuscles float) through the capillaries; this would of course mean an increase in the number of corpuscles per cubic millimetre.

In 1908 the writer carried out a series of experiments in London and Silvaplana which seemed suggestive. His average corpuscular value in London was approx. 5,400,000. During the journey of about thirty hours' duration (which meant rail to St. Moritz and then drive of 4 miles) his red corpuscular value rose to approx. 6,200,000, *i.e.* there was an increase of about 800,000 corpuscles per cubic mm. during a rise of about 6000 feet. One would imagine that it would be difficult to devise anything less stimulating to the corpuscle-manufacturing mechanism than a long railway journey, so that most probably concentration of the blood occurred. The same phenomenon has been observed by other observers and balloonists.

In the case of Haldane's party on Pike's Peak the results for different individuals varied greatly, but there was a distinct gradual increase in each case. The variation was from 115 to 154, taking 100 as normal hæmoglobin value for sea-level.

It is assumed that this slow increase probably represents abnormal production of new corpuscles, or slower destruction of old corpuscles than usual.

Some observers regard this alteration of corpuscular and hæmoglobin value as the chief adaptation to high altitudes, and it is undoubtedly important. Hingston, who was engaged in survey work on the Pamir ranges, states that a carrier of his who seemed inadaptable to high altitudes had a blood count of only 5,760,000 at 13,300 feet, whereas the rest of the party had a value of about 7,000,000. It is worth noting in this connection, however, that two of Haldane's party during nearly a month on Pike's Peak (14,109 feet) had lower average values than that which Hingston considered inadequate, namely, 5,530,000 and 5,240,000 respectively, although both were in excellent health. It is just worth mentioning also that the author at a camp at 20,000 feet had a blood count of only 6,500,000, and on ascending Pawhunri (23,180 feet) and again taking his blood count a few hours after return to this camp it was only 7,200,000. Probably diet and exercise may affect matters, and more work must be carried out.

Some physiologists have asserted that it would be impossible to carry out accurate blood-corpuscle estimations at high altitudes, and this is of

interest in connection with the psychic adaptation to the loftier Himalaya. One physiologist put the matter as follows:—

"During two successive years, Mr. Dent, Dr. Slater, and myself studied this question of polycythæmia in the Alps. We are of opinion that the counting of blood-corpuscles at high levels requires an amount of attention which no one can give when at a level of anything over 10,000 feet. Sustained mental work is out of the question at this level, and is performed with difficulty in Europe at a level of even 6000 feet. This statement we are certain would be confirmed by those who have experienced the cold and discomfort, together with the nausea and other slight symptoms of 'mal de montagne' which affects most people in some degree."

This is merely quoted to show that even first-rate observers may be misled by want of acclimatization. Probably blood counts could be made at upwards of 23,000 feet by one acclimatized to high altitudes. There was certainly no serious physiological difficulty involved in carrying out determinations at 20,000 feet, with the exception of overcoming the very distinct disinclination for serious mental work which attacks all above 18,000 feet, due to the mountain lassitude of high altitudes. This agrees with the report of Haldane's party, which states that after a few days at 14,100 feet "mental work seemed quite as easy as at sea-level."

3. *Secretion of Oxygen by the Alveolar Epithelium.*—Two theories have been proposed to explain the passage of oxygen from the alveoli of the lungs to the blood through the epithelium and capillary walls. One theory supposes that the physical process of diffusion is sufficient to explain the transference, but the other postulates that under certain conditions, *e.g.* high altitudes, the cells of the lung epithelium secrete oxygen from the alveoli and pass it on to the blood in the capillaries. According to the first theory the oxygen pressure in the alveoli would always be greater than the arterial oxygen pressures; but according to the second the arterial oxygen pressure might be higher or lower than the alveolar.

Haldane's party on Pike's Peak found that the arterial oxygen pressure in acclimatized subjects was invariably far greater than the alveolar pressure (35 mm. above or more), whereas in new-comers it was about the same, and they regard the secretory action of the lung epithelium to be one of the most important means of adaptation to high altitudes. If secretion actually occurs, then the value of the process to the climber might be very great; but Krogh and other physiologists oppose the theory, so that further confirmation is required.

This problem of oxygen diffusion and secretion is intimately bound up with the quantity of oxygen required by the body per minute at rest and during exercise. The results of different observers vary somewhat, but one may assume that the body requires during rest a volume of 230 to 270 c.c. measured at 0° C. and 760 mm. pressure, during moderate work 1200 to 2000 c.c., and during hard work 2500 to 3500 c.c. of oxygen per minute.

The following results of experiments made by Zuntz indicates the relationship between the oxygen required at sea-level and on Monte Rosa during rest and doing easy work on a glacier.

TABLE V.

	Oxygen required per minute.
Sea-level at rest, fasting	233 cub. c.
Monte Rosa do.	260 ,,
Ascending glacier on Monte Rosa ...	1329 ,,

Assuming that the quantity of oxygen required per minute during slow climbing near the top of Mount Everest was from about 1200 to 1500 c.c. per minute (a moderate computation), the question arises as to whether this quantity of oxygen could diffuse at the low alveolar pressure of 24 mm. Haldane and Barcroft seem to consider it impossible, but Krogh would say that it could diffuse. As the volume of a gas varies inversely with its pressure, the actual volume of oxygen measured at the barometric pressure of the top of Mount Everest which would have to diffuse would be about $1500 \times 3 = 4500$ c.c.

If only 1000 c.c. (measured 0° C. and 760 mm.) could pass the dividing septum, then the rate of climbing would be very slow; and if only 750 c.c. were available the rate of climbing might be less than 300 feet per hour.

In this connection one must point out that the actual quantity of oxygen used in doing efficient work depends on the training of the individual. The trained man requires far less oxygen than the untrained during an ascent because his muscular co-ordinations are arranged for maximum economy. Hueppe worked out a series of determinations, using town dwellers as an Alpine porter as subjects, with the result that the efficiency of the porter as regards work performed was about 100 per cent. above that of the untrained man.

4. *More Rapid Circulation of the Blood at High Altitudes during Moderate Exercise.*—After acclimatization on Pike's Peak the pulse rate at rest was only slightly raised in the case of three observers, and was actually diminished in the fourth case. On moderate exercise the pulse rate rose to a much greater extent than at sea-level. This would be beneficial.

General Conclusions from Physiological Data.—There is no doubt that (*a*) the rise of alveolar oxygen pressure, (*b*) the diminution in the alveolar carbon dioxide pressure, and corresponding increase in acidity of the blood, and (*c*) the increase in the quantity of hæmoglobin and red corpuscles are of great value in promoting acclimatization. If confirmed the secretion of oxygen by the lung epithelium will doubtless be further studied and might yield useful information.

As indicated above, however, much more work must be done at high

altitudes before exact evaluation of the different factors conditioning acclimatization can be made.

One might, however, work out the essentials of the problem under consideration in another way. If one could determine the relative strain under which the body has to undergo adaptation at different altitudes, the approximate difficulties in connection with an advance above 25,000 feet can be computed. The strain can be gauged by considering the relative capacities for saturation of the blood at different heights under the respective alveolar pressures which would obtain after acclimatization. These can be probably calculated within 2 or 3 mm. from a curve for the variation of carbon dioxide with altitude worked out by Miss Fitzgerald, and are given in the following table for a few well-known mountains:—

TABLE VI.

	Height.		Barometric pressure. 0° C.	Barometric pressure. 15° C.	Alveolar Oxygen press.
	Feet.	Metres.	Mm.	Mm.	Mm.
Mount Everest	29,141	8882	251·0	266·9	23·6
Kangchenjunga	28,225	8603	259·9	275·8	25·0
Nanga Parbat	26,620	8114	276·3	292·2	27·8
Kamet	25,447	7756	288·9	304·7	29·4
Aconcagua	23,080	7035	316·1	331·8	33·5
Mount McKinley and Jonsong La	20,300	6187	351·3	366·6	39·2
Kilimanjaro	19,321	5889	364·7	379·7	41·2
Mount Elbruz	18,465	5628	376·4	391·2	43·3
Mont Blanc	15,785	4811	417·2	431·0	49·5
Aorangi (Mount Cook) ...	12,349	3764	475·3	487·8	58·9
Gorner Grat	10,290	3136	514·0	524·0	65·0
Mount Kosciusco ...	7,328	2236	575·0	584·0	73·5
Rigi	5,905	1800	606·0	613·0	78·4
Ben Nevis	4,406	1343	642·0	649·0	83·6
Scafell Pike	3,210	978·4	673·0	677·0	88·7
Sea-level	0	0	760·0	760·0	102·5

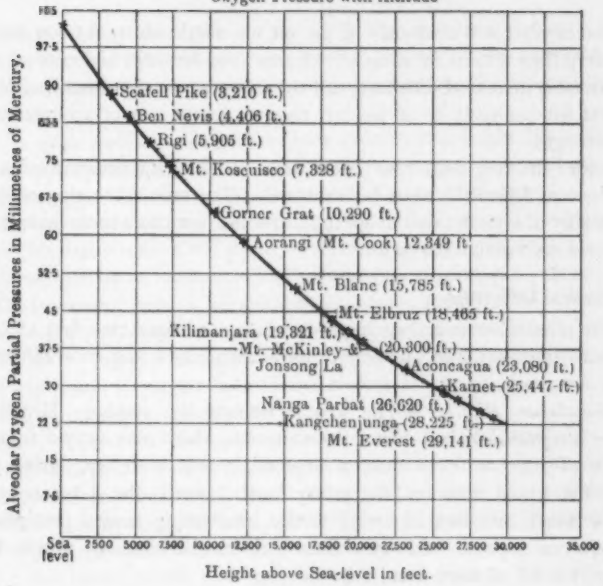
This table shows that while the oxygen in the atmosphere diminishes to one-third at the top of Mount Everest, the available oxygen, as indicated by the alveolar oxygen pressure (23·6 mm.), diminishes to less than a fourth of that at sea-level (102·5 mm. approx.). This, of course, tells heavily against the climber. The relationship of altitude to alveolar oxygen pressure is clearly seen in curve No. 3.

The relative capabilities of the different alveolar oxygen pressures at the heights mentioned to saturate the blood is well indicated by plotting the heights of the mountains on the dissociation curve of oxy-hæmoglobin in blood already given. (Curve 4.)

This curve is very suggestive. It shows that the strain on the climber is nearly negligible up to 10,000 feet and at about 15,000 feet becomes appreciable, but one must pass above 20,000 feet before the steepening of the curve indicated that the mountaineer will have to adapt himself carefully to his aërial environment. At 23,000 feet the curve is getting much steeper,

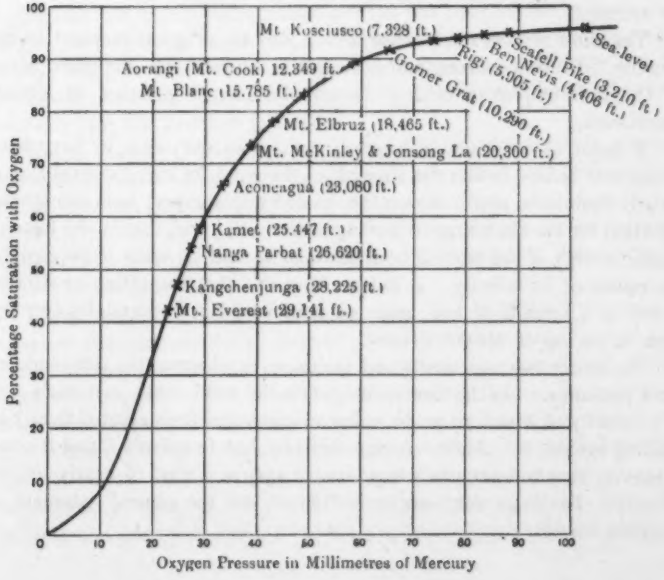
CURVE No. 3.

Curve showing the variation of Alveolar Oxygen Pressure with Altitude



CURVE No. 4.

Dissociation Curve of Oxy-Hæmoglobin in Blood with the heights of a few notable mountains plotted so as to show the saturation of the Blood with Oxygen corresponding to the alveolar oxygen pressures at their summits.



and the climber will obviously be put on his mettle above 25,000 feet, for the curve then attains its steepest. Every 1000 feet still higher must mean considerably increased difficulty, and the climber near the summit of Mount Everest will probably be on his last reserves in the way of acclimatization and strength.

Before drawing final conclusions from all the data summarized above the physical difficulties must be discussed. The mountaineering obstacles are usually of considerable magnitude, and in a few cases seem insuperable, but there are notable exceptions.

II. Physical Difficulties.

The physical obstructions might be classed as those due first of all to weather conditions, and secondly to the intrinsic rock and snow difficulties of the mountains.

Himalayan Weather.—The weather among the southern Himalayan ranges is notoriously bad during the monsoon, which may extend from the middle of June to the middle of September, that is to say, during practically the whole summer, but further north towards the Tibetan border may be much ameliorated owing to the intervening ranges precipitating the aqueous vapour. Above 20,000 feet on the southern ranges there is usually a fall of snow every day.

Mount Everest (29,141 feet) and Kangchenjunga (28,295 feet) would hardly be accessible during the monsoon, but could probably be attempted during the latter half of April, May, and the first half of June. The latter half of September and the first half of October would also be a good time for ascents.

The wind is a weather factor which may be of great moment to the climber. If not too strong and of moderate temperature—not much below 0° C.—it is helpful in raising the alveolar oxygen pressure as already mentioned.

A point of considerable interest, which does not seem to have been mentioned before, is that the strength of the wind for any given velocity is greatly diminished above 20,000 feet, as one might expect from the general equation for kinetic energy of moving bodies, $f = \frac{1}{2} mv^2$, that is, the force or kinetic energy of the moving body is equal to half its mass multiplied by the square of its velocity. It follows from this that the lifting or striking power of a tornado of 100 miles an hour would be reduced by 66·7 per cent. at the top of Mount Everest.

The writer has repeatedly had occasion to observe this difference of wind pressures. On the Grampians, when the wind roars past one's ears at a velocity of about 70 or 80 miles an hour, one finds great difficulty in pushing against it. Above 20,000 feet one has frequently found it comparatively easy to force one's way forward against a wind of nearly similar velocity. To gauge the velocity is difficult, but the general statement is certainly correct.

There is, however, one serious difficulty in connection with wind, namely, the low temperature sometimes met with. An intensely cold north or north-east wind might drive one down to avoid frostbite of hands and feet.

The snow and rock difficulties vary greatly, and might be best illustrated by consideration of the possibility of ascent of a few of the chief peaks, but space unfortunately only allows of a few brief notes.

Many of the most magnificent mountains of all present such physical difficulties that climbers will probably await attacking them until the effects of altitude are better understood. K_2 (28,253 feet), Makalu (27,790 feet), the Gasherbrum Peaks (I. 26,470 feet, II. 26,360 feet, III. 26,090 feet, IV. 26,000 feet), the Masherbrum Mountains (E. 25,660 feet, W. 25,610 feet), Nanda Devi (25,645 feet), Rakaposhi (25,550 feet), Boiohagurdoanasur or Hurza Kunzi (I. 25,370 feet, II. 25,118 feet, III. 25,050 feet), and Jannu or Jano (25,294 feet) are all difficult.

Many of these peaks seem impervious to direct assault, and if on close investigation that were found to be the case, they may be attacked in some future decade by aeroplane or airship. They will certainly be ascended. At present climbing by airship would probably be regarded as an unwarranted innovation by all true mountaineers.

Of the peaks which look possible of ascent Kāmet, Nanga Parbat, Kangchenjunga, and Mount Everest are of special interest.

Kamet (25,447 feet) is at present the most interesting of the peaks between 25,000 and 26,000 feet, because it is the most accessible of all, and is admirably adapted for carrying out acclimatization experiments. Lying back on the Tibetan border behind the main chain in the Zaskar Range, it is not so much affected in the rainy season as peaks like Mount Everest or Kangchenjunga, which bear the full brunt of the monsoon. It could therefore be attacked with distinct hope of success between May and October inclusive.

Nanga Parbat (26,620 feet) is one of the most fascinating summits of the main range. Mummery, in 1894, carried out the only difficult climb yet effected in the Himalaya, ascending rock ridges of the north face to about 21,000 feet. After examination from a spur of the adjacent Ganals Peak in 1913, the writer came to the conclusion that the north arête is practicable.

Kangchenjunga (28,295 feet) is in some ways the grandest mountain mass on the surface of the planet. Mr. Freshfield made the first near circuit of the mountain in 1900, and examined the eastern and western faces with regard to the possibility of climbing them. Regarding the magnificent eastern face, the finest ridge I have ever seen, he describes it as "a broad line of cliffs of terrific steepness which appeared hopelessly inaccessible to any direct attack." The only chance would be along the north-eastern arête, of which he writes as follows: "The right-hand buttress is a marvel of mountain architecture; it springs from a low mass

as pedestal of splintered granite, and flies up in an ice arête of a length and steepness which defy Alpine comparison." The western face is also difficult.

The south face presents a practicable but dangerous route of ascent. During an attempt from this direction in 1905 four men lost their lives, being swept away by an avalanche. The height attained was about 21,000 feet.

Mount Everest or Chomo Langmo (29,141 feet).—As the latter name was obtained by Colonel Bruce and the writer from quite different sources, its claims may be worth consideration at a later date. A pass to the north-east of the mountain, about 18,500 feet high, leading to Kharta near the Arun River, is called Langma La. The mountain may be assailable from the north-east or north.

While the limited scope of this paper hardly allows of the deduction of categorical conclusions, yet it is highly probable from the data cited that a man in first-rate training, acclimatized to maximum possible altitude, could make the ascent of Mount Everest without adventitious aids, provided that the physical difficulties above 25,000 feet are not prohibitive. A supply of sodium peroxide (Na_2O_2) to provide oxygen as an occasional refreshment would be of great value. It is intended to discuss the incidence and causes of mountain sickness, as well as the limits of acclimatization, and the possible rate of ascent above 25,000 feet, in an extended paper.

The author would be grateful for any practical unpublished information directly bearing upon the physiological effects of high altitudes, and in particular abnormal mental or physical effects observed by airmen above 20,000 feet.

The author has pleasure in expressing his obligations to Dr. Carl Browning, Director of the Bland Sutton Institute of Pathology, for kindly reading and criticizing the manuscript.

Before the paper the PRESIDENT said: The Poles having both been reached it is obvious that the next object of importance on the Earth's surface to be attacked by adventurers is the highest mountain in the world. There are, perhaps I should not say unfortunately, a good many difficulties in the way of reaching it. In the first place you have to deal with a Government which has up to the present time forbidden you to approach within 100 miles of the mountain's base. In the next place the mountain itself is probably—though of this we have no sufficient evidence—of considerable difficulty; and there is thirdly the main obstacle, the effect of the rarity of the air at great heights on the human frame. As you know, the greatest heights reached at present are 24,600 feet by the Duke of the Abruzzi's party and 24,000 feet by some young Norwegians on Kabru, one of the mountains nearest Darjeeling.

Dr. Kellas, who is going to lecture to us this afternoon, will deal with this question of the effect on the human frame of high altitudes, and there is no one in Europe who can deal with it with greater authority or greater practical knowledge. He is a mountaineer himself; he has gone to the Himalaya several times, always to the Sikkim frontier. There, without Alpine guides, himself the only European in the party, Dr. Kellas, with a few hillmen whom he has trained

to climb on snow and ice, has reached several summits of between 22,000 and 23,000 feet. He therefore adds practical experience to the scientific knowledge of an eminent chemist competent to deal with the medical side of the problem.

(*Dr. Kellas then read the paper printed above and a discussion followed.*)

Lieut. C. MEADE: In travelling in the Garwhal Himalaya at high altitudes, I have always found the sun peculiarly formidable. My coolies were all accustomed to living above 11,000 feet, but at heights above 20,000 feet I used to forbid them taking siestas in the open. I believe that exposure to the sun's rays at such a height is an important factor in causing mountain sickness.

The PRESIDENT: I should like to ask Dr. Kellas one or two questions. He told us about the unfortunate experience of the people who went up Pike's Peak by train. There is a similar ascent made by railroad in Switzerland up to the Jungfrau Plateau—11,300 feet. I do not know whether he has any statistics of what the effect on passengers in those trains has been. I recollect when there was a serious project, happily brought to naught, of making a railroad or lift up through the middle of the Matterhorn. It was proposed that caves should be excavated on the summit, and one of the caves was to be for a resident doctor who was to attend on distressed or collapsed tourists when they arrived on the top! It is not usual for healthy people to suffer at the height of 11,000 feet unless they are brought up suddenly from sea-level or from relatively low altitudes. On the top of Mont Blanc (15,700 feet) many climbers suffer little or no inconvenience.

On one occasion when a hut was being built on the summit the workmen who lodged in a lower hut at a height of 14,300 feet used to run up the last ridge at as good a pace as you or I might run up Primrose Hill. I found it hard work, but still possible to keep up with them. One of the puzzling things in mountain sickness is the way in which the symptoms vary, not only with different individuals—some people, as in the case of sea-sickness, suffering far more than others—but vary on different mountains and on the same mountain on different days. For example, the first ascent to the top of Elbruz, 18,500 feet, in the Caucasus, was made by an English party in very good training; none of us suffered at all. The summit being a crater with a rim to it, we ran about on the rim; while the next party, who were equally good mountaineers and in equally good training, suffered severely. The only explanation I can offer is the difference between the weather on the two days; on the first day there was a very high wind. That may possibly have increased the supply of oxygen.

Dr. Kellas has indicated the right line of research and practical experiment. He has also enforced a lesson that may be useful, and possibly even save lives: that is that climbing in the Himalaya is not to be lightly undertaken in the spirit of certain travellers who have boasted of running up them in their shoes, but is a task which requires careful preparation beforehand and a readiness to profit by previous experiences. I believe—I do not suppose I shall live to see it—that the highest mountains will be climbed, and I hope climbers will not lose time about it, else they may find themselves anticipated by airmen.

I do not know that I can add anything to the very careful deductions we have had from the chemistry of the human frame, but would ask Dr. Kellas if there is anything he would like to add now, and I am sure you will wish me particularly to thank him for the very fine set of photographs he has shown us, which will give you some idea of the great variety, the enormous majesty, and of course the very great difficulty, in many cases, of the Himalayan Mountains.

But among so many there must be a few easy ones on which experiments may be made by those who are testing the rarity-of-the-air problem.

Dr. KELLAS: First with regard to the effect of the sun mentioned by Lieut. Meade: there is no question that above 20,000 feet the sun's glare is terrific, and it is most inadvisable to think of sleeping in the exposed open. The effect must depend upon certain specific rays, probably ultra-violet rays, but perhaps also others which are filtered off lower down. I could not give any more definite reason, but I have noticed, when camping with thin tents on snow above 20,000 feet, that one has to cover the tents with opaque material to keep the sun's rays out, otherwise they are almost uninhabitable, especially if the air is stagnant.

With regard to the President's remarks about the apparently different effects of altitude on the first and second parties which ascended Mount Elbruz, the point he mentioned as being different on the two days was certainly one cause. Wind has a considerable effect on the breathing when climbing at altitudes over 20,000 feet, and is also important at lower elevations. I have noticed repeatedly that a high wind helps one greatly. There are various reasons which might be adduced: In the first place, when there is a breeze the exhaled air is carried away and none of it is re-inhaled. Secondly, air is packed into one's lungs by the breeze. This aids in the pressure, driving oxygen into the tissue between the capillaries and the alveoli of the lungs.

The PRESIDENT: In the early ascents of Mont Blanc in the eighteenth century, when they went up the great valley they always complained of the aridity and the stagnation of the air up at 12,000 or 13,000 feet in this hollow in the mountain; it seemed to cease when they got on to the ridges.

Dr. KELLAS: One reason usually given as an explanation is that snow takes up more oxygen than nitrogen. One would not expect much effect unless the air were very stagnant, but there might be other reasons, such as reverberation of the sun's rays from the snow. Both could be investigated experimentally.

HAKLUYT AND MULCASTER

Prof. Foster Watson

HAKLUYT, it has been asserted, cannot be included in the highest rank of the great men of literature. Judged by his literary style no doubt this is true, as it would be true of Roger Ascham, of Thomas Fuller, or of Samuel Pepys. Still, such writers as these belong to a class which has a greatness of its own, not always reached by those who surpass them in the dignity of the highest literary style. They are men who draw towards them the affections of their readers on account of their personality, which finds expression in their work. Style and matter become united, for the concrete subject-matter is of high human interest, and the style is determined by the mode of expression which the personality finds inevitable for spontaneity and completeness of utterance.

Hakluyt's absorbing passion is that of patriotism—devotion to England. England, for him, is identified with the old Viking spirit, adventure on the sea, which in itself is sufficient to absorb all a man's thoughts. But Hakluyt, with the love of romance at sea as deep-set as that of Cervantes on land,

is also a prophet. He foresees that sea-enterprise can establish settlements from the mother-country. He, with Gilbert and Raleigh, form the Pioneering Triumvirate and are the fathers of the British Colony of Virginia for which James I. granted the Patent in 1606. And, again, Hakluyt is the pioneer of technical training of the navigator. He wished English sailors to be as well equipped as the Spanish seamen. The latter, as Hakluyt was always pointing out, had a handicap in their favour, since there was an official reader in cosmography, mathematics, navigation, at the Casa de Contratación at Seville, whose business was to expound the theory of seamanship. There was, moreover, a board of examiners to examine, theoretically and practically, every man desirous of becoming a sailor. The candidate had to show that he had profited by the reader's lectures, and also that he understood the application of theory to the management of a ship, and that he could practically manage one. Moreover, seamen were taught how to keep an accurate daily record of their course and of the ocean currents, as well as a precise description of all shores coasted; and these descriptions were to be brought to the pilot-major at Seville to be placed among the archives. No seaman was allowed to be in charge of a vessel going out from Seville without a licence from the examining body thus appointed by the Spanish Council for the Indies. Thus Spain possessed a registry of duly qualified and tested pilots, and required the training, theoretical and practical, of its navigators.

Hakluyt advocated a similar training for English sailors. "Seamen," he said, "are not bred up to perfection of skill in much less time than in the time of two 'prenticeships; and since no kind of men of any profession in the commonwealth pass their years in so great and continual hazard of life; and since of so many, so few grow to grey hairs; how needful it is, that by way of lectures and suchlike instructions, these ought to have a better education than hitherto they have had; all wise men may easily judge." His appeal for an English College of Navigation, or at least a Reader to instruct sailors, to be established at "Ratcliff or elsewhere" is reinforced by what one would have thought an irresistible plea :—

> "When I call to mind, how many noble ships have been lost, how many worthy persons have been drenched in the sea, and how greatly this Realm hath been impoverished by loss of great Ordinance and other rich commodities through the ignorance of our sea-men, I have greatly wished there were a Lecture of Navigation read in this City [of London] for the banishing of our former gross ignorance in Marine causes, and for the increase and general multiplying of the sea-knowledge in this age, wherein God hath raised so general a desire in the youth of this Realm to discover all ports on the face of the earth, to this Realm in former ages not known."

Such were the arguments of Hakluyt for the training of English sea-captains and seamen generally.

Richard Mulcaster, his contemporary, was headmaster of Merchant Taylors' School from 1561 to 1591, in which year he became headmaster of St. Paul's School, under the Mercers' Company. In his 'Positions' (1581) he pleaded for a College for Mathematics, in which he wished amongst others "shipmasters" and "mariners" might study, so that therein he is on common ground with Hakluyt, who regards Mathematics and Astronomy as basal sciences for Navigation. Like Hakluyt he uses the term "reader" for the teacher who is to be provided, in "great allowance," "to make their haven there [*i.e.* in or near London], where ye mean to use them."

The parallel, therefore, between the views of Hakluyt and Mulcaster is suggestive. But from the historical aspect it must be pointed out that Mulcaster's 'Positions' was published in 1581, and Hakluyt's 'Principall Navigations' (first volume of the second edition from which the above passages on the training of the seamen were taken) appeared in 1598. If there is any direct indebtedness of the one to the other, in the presentation of these educational views, it would seem chronologically to be more likely that Hakluyt applied Mulcaster's views to the subject of seamanship than *vice versâ*.

There is a further parallel to be observed between Hakluyt the Preacher and Mulcaster the Schoolmaster. As Hakluyt is the first advocate of the training of the English seamen and the promotion of seamanship into a profession, Mulcaster is similarly the first advocate of a training-college for teachers, and the raising of the teachers into a profession parallel with the divines, lawyers, and physicians.

Mulcaster's arguments are not dissimilar to those of Hakluyt. "Ships are to little purpose without skilful sea-men," says Hakluyt. So with Mulcaster, teachers without skill will "mangle" their work and be but "meddlers." Each is impressed with the importance of the training of the men employed in his special calling. Hakluyt points out the drowning of incompetent sailors and the loss of goods entailed by ignorance. Mulcaster asks: "Be either children or schools so small a portion of our multitude? or is the framing of young minds and the training of their bodies so mean a point of cunning? be schoolmasters in this Realm such a paucity, as they are not even in good sadness to be soundly thought on?"

Both Hakluyt and Mulcaster have firmly grasped the idea of the value of preliminary professional training. Both, it may be noted, were unsuccessful in their efforts to secure such training; the one for seamen and the other for teachers. The two men were further united by the main aim of their public endeavours.

Hakluyt advocates the instruction of seamen "with severe and straight discipline," and declares that "if this one thing (training) be added I assure myself it will turn to the infinite wealth and honour of our country, to the prosperous and speedy discovery of many rich lands and territories of heathens and gentiles as yet unknown, to the honest employment

of many thousands of our idle people, to the great comfort and rejoicing of our friends, to the terror, daunting and confusion of our foes." Mulcaster declares "the very end of my whole labour, if my small power can attain to that, which a great good will towards this my country hath deeply conceived, is to help to bring the general teaching in your Majesty's dominions to some one good and profitable uniformity." His spirit of patriotism is sincere, and has something of the intensive quality of that of Hakluyt. One of the reforms he advocated, to help forward the task of training the teachers and teaching in the schools, was the use of English instead of Latin as the medium of instruction. The unreserved admiration of Hakluyt for Elizabethan navigators is paralleled by Mulcaster's appreciation of the use of English by Elizabethan writers. "Whatsoever shall become of the English State" (this was written in 1582 before the defeat of the Spanish Armada, and before the publication of Spenser's *Faërie Queen* and of Shakespeare's Plays), "the English tongue cannot prove fairer than it is at this day. . . . I take this present period of our English tongue to be the very height thereof, because I find it so excellently well fixed, both for the customary writing thereof, as either foreign workmanship can give it gloss or as home-wrought handling can give it grace."

Love of England was the inspiring motive of both Hakluyt and Mulcaster. They were both empire-builders, the one by his devotion to the history of the romance of the sea, and his preaching of the sailor's spirit of daring courage as a national characteristic; the other by his deep-rooted attachment to the English language (though he wrote it so badly himself), which was an essential basis of the unity of England and her prospective colonies, when Hakluyt's vision of a Greater Britain became a reality.

Both Hakluyt and Mulcaster were correspondents of the great geographer and cartographer, Abraham Ortelius of Antwerp, who in his great Atlas gives a list of 150 geographical works which he had consulted, whilst Hakluyt himself collected descriptions of 200 voyages, many of which we should not have heard of but for him. Hakluyt wrote at least one letter to Ortelius, sending suggestions for a reform in the drawing of maps.

In the second edition of the first volume of Hakluyt's 'Principall Navigations,' in 1598, we see that Mulcaster was in direct touch with Hakluyt, for he writes two sets of panegyric Latin verses on the author and his book, and from these verses we gather what we were desirous of discovering—that Mulcaster was enthusiastic both with regard to Hakluyt and with regard to geography.

Not satisfied with one set of verses, Mulcaster supplied a further Latin poem to the following effect: "He who first sang in weighty song of the Golden Fleece and of the Greek leaders whom Jason associated with himself, made known how they claimed they had cut through the salt waves and thus won the undying rewards of mighty fame. If so great a praise followed on the pen telling of the deeds of a single ship, how great glory

remains for Richard Hakluyt, whose quill has described a thousand straits, a thousand swift vessels, starting from our island, which have flown through all the places of the immeasurable world! Thou wilt receive the thanks of thy country, for ever mindful of thy praiseworthy industry. All this care of thine will go forth to the whole earth. Thou wilt teach us to cherish with all zeal, our ships of oak and our hearts of oak. By these defences, whosoever harasses the English people, he shall he made to pay for it."

Another writer of panegyric verses to Hakluyt's great book was Marc Antonio Pigafetta, "gentilhuomo Vicentino," who wrote his verses in Italian. He evidently belonged to the same family, though probably to a collateral branch, as the famous Antonio Pigafetta who made the journey round the world with Magellan, 1519–1522, and it is very fitting that a foreigner's verses should have been included to introduce the work of a man like Hakluyt, one of whose characteristics, in spite of his absorbing devotion to his country, is his international outlook. Pigafetta represents the Earth as speaking and saying, "Unknown should I have been to myself, with little honour buried in the obscure old maps, if one of my sons had not now disclosed my splendour at great cost of skill and of money." It is true Ramusio had made manifest many parts of the surface of the globe, but Hakluyt has supplemented his accounts, with "genuine disregard of weariness and of expense." Pigafetta wrote a book (in Italian, though published in London, 1585) entitled 'Itinerario,' giving an account of a journey from Vienna to Constantinople. In his Preface he mentions that he would have destroyed his manuscript or at least kept it "private" (through a feeling of desperation of modesty) had it not been that he was "exhorted, principally by Mr. Richard Hakluyt, a young man (*giovine*) endowed with a kind and noble mind, and not only learned in the knowledge of his calling, but also both learned in and devoted to matters of geography."

Besides Pigafetta, the other introducers in verse of Hakluyt are Hugh Broughton and William Camden the Antiquary. Broughton, who was one of the most learned Hebraists and orientalists of the time, wrote Greek verses, in which he spoke of the graphic style of Hakluyt "whose memory will always live." Hugh Broughton knew Mulcaster, whom he described as one of the best Hebrew scholars of the age.

William Camden was headmaster of Westminster School, Hakluyt's old school, but Hakluyt had left in 1570, and Camden was connected with Westminster 1575–1599. Camden, in fact, was probably about a year or two older than Hakluyt. He too was at Christ Church, Oxford. He left in 1571, so Hakluyt may have known him at Oxford. Camden's Sextain is inscribed "To that uncommon work of Richard Hakluyt concerning Navigations to the lands furthest removed from us"—and may be rendered:—

> "England, till now shut off from all the earth,
> Has led its own small life within its narrow girth.

> But now she has the distant countries found,
> High praise will lands, both great and small, propound.
> And what should Earth of Hakluyt's story say?
> All Earth,—no less; its mead to him will pay."

We see, then, that the introducers of Hakluyt's great work to the public were Richard Mulcaster, Pigafetta, Hugh Broughton, and William Camden. That is the complete list. It is mainly, perhaps entirely, a list of teachers. Mulcaster, the trainer of teachers and the advocate of the school teaching of drawing, here directly identifies himself with enthusiasm for the aims of Hakluyt, as a developer of the history of geographical discovery. Pigafetta probably was a teacher of Italian, at any rate, whilst in England. Broughton is a pioneer in the teaching in England of Hebrew and oriental languages. William Camden was at the head of English schoolmasters, with the possible exception of Mulcaster himself.

SAND-DUNES IN THE PERUVIAN DESERT

W. S. Barclay

IN February 1911, being stationed for some time at La Paz, Bolivia, I took the opportunity of visiting the Pampa del Sacramento in its stretch of about 50 miles between Arequipa and the Pacific coast-hills. This Pampa (the word is used here in the sense of "level ground") is really a continuation of the barren lands of Northern Chile, characterized by Charles Darwin ('Voyage of the *Beagle*') as one of the true desert spots in the world; it is crossed transversely by the southern railway of Peru. A remarkable feature of the Pampa del Sacramento is its moving sand-dunes, and it was to study the formation and action of these dunes that my visit was made.

Although the majority of the dunes are to be found in the western half of the Pampa the sub-aerial weathering of the conglomerate bed from which they take their origin is noticeable elsewhere along the Peruvian coast. One of my most vivid recollections on the steamer voyage along the desolate coast from Lima to Mollendo is a vision, against the early morning sun, of a great flame-coloured hill that seen through the coast fogs presented almost the appearance of a city on fire. This flame effect was, as I afterwards ascertained, due to sand and dust blowing across its upper ridges.

Starting from Mollendo the railway winds its way up the deeply eroded flanks of the coast hills. The hot air rising from the desert keeps back or dissolves the clouds which attempt to make their way across the Andean crests to the sea, and rain is reckoned to fall on this coast not more than once in seven years. When this occurs, however, its erosive effect on the soft, loose soil is striking. Watercourses 15 to 20 feet deep are cut in a

few hours. One of these rare rain phenomena had taken place a few days before my visit. It does not pay the railway, when constructing its track, to allow openings for these infrequent cloud-bursts, and one sees in consequence solid earth-banks built along the hill-flanks, damming gulleys of great depth extending sometimes a mile or more on the up-side.

On reaching the Pacific fringe of the Pampa, or Desert, del Sacramento, after an ascent from the coast of some 4000 feet, one begins to feel the wind which is responsible for the formation of the dunes. The general direction of this wind is from the north-west, being caused by radiation from the desert surface and the consequent inrush of cooler air from the Pacific. It blows at about 20 miles an hour, and the sand which it releases travels about 2 miles an hour on the hard flat surface between the ridges. The wind starts as soon as the desert warms up and increases in violence with the rising temperature, attaining its maximum force between 2 p.m. and sunset.

The conglomerate bed of this desert Pampa is chiefly formed of the following constituents, in order of their importance: quartzite, tufa, gypsum, diorite (with iron and pyroxin crystals), and quartz. The whole is packed and blended by the gypsum which has run into and filled fractures made perpendicularly, thus facilitating weathering. The tufa is found in beds also in the neighbourhood of Arequipa, and is cut into blocks for building purposes. They ring when struck like well-burnt bricks. The quartzite forms the main mass of the hills surrounding the desert. It weathers into a brick-red oxide on the surface, which gives the desert its tone, making the slaty-white sand-dunes noticeable by contrast. The quartz is infrequent. Diorite is interspersed in the conglomerate, but in angular form showing no signs of water-wearing; it must therefore be attributed to volcanic ejecta. The genesis of the sand-dunes is best seen on the Pacific or western fringe of the desert, where the winds are eating away the conglomerate ridges (possibly the remains of an ancient higher level), which run out from the quartzite hills in a direction at right angles to the prevailing winds.

On the western border of the desert the sand remains largely inchoate, but after about 15 or 20 miles dunes begin to appear, and these increase in number till on nearing the inland fringe, some 25 miles from Arequipa, they can be observed in serried battalions accompanying the railway.

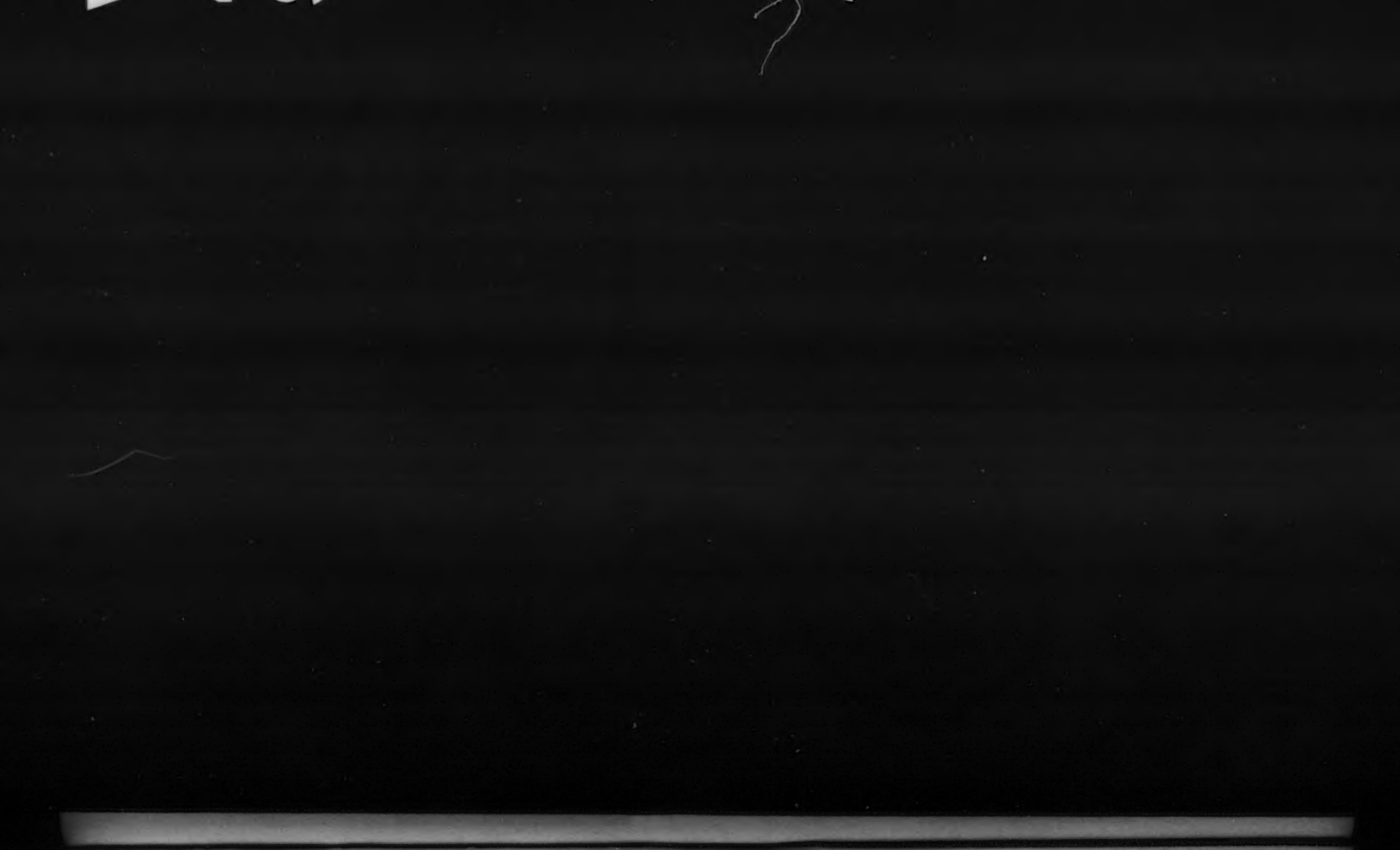
Once formed, the dunes take their typical half-moon shape and proceed in stately sequence south-east across the Pampa until they reach some large obstacle or abrupt change of level. If the barrier is negotiable they adapt themselves to cross it, the dune projecting itself into the easiest passes and elongating up to the limit of its sand-mass. Once the obstacle is crossed, the vanguard of the dune marks time until the rear catches up, forms once more into a half-moon shape and proceeds on its way. These dunes often attain a considerable size, measuring up to 50 yards between the points of the horns.

CONGLOMERATE BED OF PAMPA DEL SACRAMENTO, AND MODE IN WHICH THE SANDHILLS ARE DERIVED FROM IT

ARRANGEMENT OF DUNES: PLATEAU OF CONGLOMERATE FROM WHICH THEY ARE DERIVED, AND PEBBLE-STREAM SURFACE OF PAMPA

SAND-DUNES CROSSING THE RIDGES ON PAMPA DEL SACRAMENTO

CRESCENT DUNES ON THE PAMPA DEL SACRAMENTO, MOLLENDO—AREQUIPA RAILWAY



The march of the dunes is assisted by the sand ripples, whose more exposed surfaces are blown onward by the wind. The sand climbs the steep back of the dune more slowly than the low salient wings—hence the half-moon shape. Small particles travel at relatively high speed near ground-level as far as the projecting points, or horns, but as soon as they reach them they are in the lee of the wind and their further progress is checked until the mass of the dune catches up. Thus the distance the sand travels along the points is dependent on the maximum height of the back of the dune, and this in turn depends on the force of wind. The stronger the wind the higher it will force up the sand particles in a direct right angle to the axis of the dune, *i.e.* to a line drawn between the horns. The shape of any given dune is therefore the result of a perfectly graduated balance between the wind-force and the floor-level. The railway track in crossing the desert shows an average rise of slightly over 1 in 100, so that although their shape is governed by surface variations the dunes are on the whole marching uphill.

Owing to my short stay in the Pampa I was not able to check the dunes' rate of march by personal observation, but I was informed by plate-layers and other railway-men whose duties necessitate watching them, that the rate is about 100 yards per annum. The high hills flanking the desert near Arequipa are too steep to allow the dunes to proceed further. They therefore pile up in a sort of sandy cemetery at the eastern edge of the Pampa. Before they reach the end, however, and as the hills deflect the air in different directions, dunes occasionally advance over or threaten the railway line. The method of avoiding the threatened obstruction is simple but efficient. A couple of men go out with long-handled spades and a wheelbarrow and collect loose pebbles and grit from the surface of the Pampa. This they proceed to scatter in a thin layer over the back of the unfortunate dune. The pebbles arrest the action of the ripples and so interfere with the even circulation of the sand particles, which is apparently as essential to the progress of the dune as the circulation of blood to a human being. Very shortly the dune assumes a lopsided shape, sagging where the *débris* has been cast upon it and offering, instead of a well-rounded back, a breach to the action of the wind. The process of disintegration is fairly rapid, and at the end nothing is left on the Pampa except the original wheelbarrow loads of grit and pebbles which sufficed to exorcise the monster.

The dunes advance over pebbles and stones without disturbing their position. I noticed immediately behind several large dunes scattered stones (which may also be noted in the photographs) that obviously had not shifted from their bed, just as pebbles may lie secure on the seashore in the swell of the breakers. Generally speaking, the smoother the surface of the Pampa and the higher the wind, the larger and more perfect becomes the dune.

The Pampa del Sacramento is a true desert without a vestige of

vegetation, even immediately after cloud-bursts, the wind-blown sand being apparently fatal to nascent growth. Outside the influence of the desert wind the soil, as in the case of Egypt, is extremely fertile under irrigation. But on the desert surface of the Pampa there are not even insects. The sand preserves its contents well. A quantity of flint-locks, dating from early Spanish times, were found; also the body of a mummified woman, who probably died during the construction of the railway forty years ago. The Vitor stream which crosses the Pampa on the northern fringe of the sand-dunes formed a recognized route in the journey from the coast to Lake Titicaca even in the time of the early Spanish occupation. Both for those early travellers and for the railway the beacon that points the way across the dreaded desert remains the same—the twin snow-clad summits of Misti and Horcones, the irrigation from which makes of Arequipa a green oasis in this sterile wilderness of hills.

NOTES ON THE KIRIN PROVINCE, MANCHURIA

MR. K. H. von Lindholm, the Commissioner of Chinese Customs at Hunchun in South-east Manchuria, has sent the Society some notes on the country around his post, to supplement a report of his which was published in the last series of Decennial Reports of the Chinese Maritime Customs (1902-1911). This region came into prominence a few years ago because of a dispute with Japan, in which a claim was made that it properly came within Japanese jurisdiction as a part of Korea.

Hunchun was "opened" to trade by the Manchurian Convention which was concluded between China and Japan in 1905. It lies on an affluent of the Tumen 10 miles from the Korean boundary and 15 miles from the Russian. It is comparatively modern and dates from 1714, when K'ang-hsi established a small military post there dependent on Nuiguta. But the country around is said to have a history dating back to the Sung dynasty (12th century) when it was known as Hai-lan-lu, a name which was changed to Hai-lan-fu under the Mongol Yüans (13th and 14th centuries), and to Chien-chou-wei during the Ming Dynasty (14th to 17th centuries). At the time of the Manchu conquest of China these parts were inhabited by Manchus (Nüchên), who had absorbed Yüpitatse ("Fishskin Tartars") as well as remnants of earlier Korean colonies. The campaigns of the Manchus are said to have drained the population to the point of extinction, and when Europeans first made practical acquaintance with the region in the 19th century large districts had been kept unpeopled as a matter of policy by the Manchu emperors. The Koreans were told that their frontier was the Tumen, and for centuries they had been forbidden to cross it under the severest penalties. About forty or fifty years ago the prohibition was relaxed to the extent that Chinese colonists from Shantung and Chihli were encouraged to settle all along the Korean borderlands, and the

THE HAI-LAN HO RAPIDS

A KOREAN VILLAGE

MARKET DAY, LUNGCHINGTS'UN

THE HAI-LAN HO FROM HILLS TO SOUTH-WEST OF LUNGCHINGTS'UN, LOOKING TOWARDS TOWTAOKOW

Koreans also crossed the Tumen, shaved their heads as a rule, and adopting Chinese dress were regarded as Chinese subjects. The annexation of Korea by Japan led to a great influx of Koreans, so much so that the Koreans greatly outnumbered the Chinese, and this state of affairs invited the claims made by Japan to jurisdiction over the so-called Chien-tao districts in the south-east of the Kirin province.

Hunchun is a small mud-walled town with a notable trade, which is carried by pack-animals and carts to and from Novokievsk, Korea, and Kirin. The population is only 2600. The total population of the two south-eastern prefectures of Kirin, Yenchi, and Hunchun, was officially stated as 53,675 in 1915, but Mr. Lindholm considers that these figures do not take account of the recent increase of Korean emigrants. In any case they show a remarkable advance from the sparse population of fifty years ago, and they led Mr. Lindholm to draw attention to the potentialities of the land. In the sketch-map he sends with this paper, which has been compiled from Chinese sources, he marks many localities where minerals, gold, silver, and coal, abound. Until recent years mining was prohibited, but secret work had been carried on for a century and more, and nowadays there are 3000 men engaged chiefly on gold washings at Santaokow. "Coal, sometimes very good, is found in so many places that one feels inclined to say almost everywhere." The soil is fertile and farming is profitable. There is no lack of water. Local floods occur in the valleys, but "could without great difficulty or expense be remedied." Hunchun is not far from Novokievsk and Vladivostock; labour is cheap; the taxes are low; and a "really competent and energetic modern agriculturist could hardly fail to make a very good thing of farming here if he had somebody at Vladivostok to see after the safe disposal of his produce."

"It is not suggested that these districts are an Eldorado, but, as stated before, there are possibilities of no mean order as regards mines, agriculture, and timber in these districts *close to the sea* and favoured with an excellent climate, and it must strike others, as it has done me, who have travelled much and have seen men leading lonely and hard lives engaged in enterprises from the Arctic regions to malarial swamps in the tropics, as strange that these places continue to remain practically wholly unnoticed by the world generally."

"I do not think that the Chinese would in any way be opposed to enterprises undertaken here by people from Europe and America, arranged in such a way as would prove of benefit not only to the concessionaires but also to the Chinese themselves. But before such could be safely undertaken means of communication and transportation, which now are lacking, must be secured as well as the 'open door' in more than name only. The Seishin–Hui-ning–Lungchingts'un–Kirin railway will in some years' time provide an outlet. It is more than likely that eventually a light railway will be built which will connect Hunchun with Possiet (or perhaps Hanchi, which is the better anchorage and place for shipment)."

"When goods can be easily transported by rail to Seishin and Possiet Bay for shipment these districts will develop quickly. If then there is a real 'open door' policy, and the rail-borne goods, which have to pass through either Japanese or Russian territories to the nearest places of shipment, can be transported without any customs or other obstructions, these districts may prove attractive fields of enterprise for Western Europe and America."

This note was accompanied by a sketch-map compiled from Chinese sources and maps, in which Mr. Lindholm has shown much detailed information as to mines, trade marts, and customs barriers. It is not possible at the present time to reproduce this map in the 'Journal,' but it has been placed in the Map Room of the Society for reference.

FRONTIERS IN THEORY AND PRACTICE

Political Frontiers and Boundary Making.— Colonel Sir Thomas H. Holdich, K.C.M.G., K.C.I.E., C.B., D.Sc. 8vo. London: Macmillan & Co. 1916. *Price* 10*s*.

THIS important work by Sir Thomas Holdich demands immediate attention, because it is essential that in the near future we should have a public opinion well instructed in the principles of frontiers and boundaries. At the same time the book requires the most mature consideration, because it deals with some of the most delicate problems of politics and strategy, it treats of matters which are very controversial, and it ranges with its author's experience over a much larger portion of the world than is familiar to any one reviewer. Under these circumstances the best course is to give a plain account of the principal lines of thought and features of interest in the book, leaving to the future a critical discussion of the many points on which opinion will not be unanimous.

The author explains in his introduction that in the very scanty literature on the subject of international boundaries he had failed to find an authoritative opinion based on practical experience. On the other hand, much had been written lately from the academic point of view, embracing a prospect of a world anxious to dwell in bonds of mutual good-will and international brotherhood. Sir Thomas Holdich starts with the assertion that these theories of the principles which should govern the adoption of an international boundary by no means agree with the exigencies of a practical delimitation. In flat contradiction to Prof. Lyde and to those who with him would place the frontier "where men naturally meet," our author believes that the first and greatest object of an international frontier is to ensure peace and good-will between contiguous people *by putting a definite edge to the national political horizon*, so as to limit unauthorized expansion and trespass. With this as his root principle he sets out to show "how

much at variance with the theory of idealists are the hard facts of practical necessity."

In the first chapter Sir Thomas sketches the Evolution of the Frontier, starting with the thesis that primitive man abhors the boundary, and that in primitive lands the cattle-owner is the recognized lord of the soil; this he illustrates by interesting remarks drawn from his Indian experience of Kirghiz and Ghilzai nomads, of Todas and Bhils. Chapter II. discusses the Constitution of a Nationality, and especially the ease or difficulty with which different conquering races can assimilate the conquered, or pioneers of development assimilate the mixed crowd of immigrants which will sometimes follow in their track. Central Asia and South America naturally provide the grounds of illustration; and it is interesting to note how nearly the author agrees with Lord Bryce in his remarks on the curious power of attraction by which the Argentine and other South American states absorb into their nationality those who settle in the country. In speaking of the Argentine and Chili he brings forward a strong example to support his theory of a good frontier: "On either side the Andes are two great Republics, speaking a common tongue and recalling an ancestry which, if not absolutely common to both, at least belonged to one national unit—Spain. The only difference in origin is that which lies between the northern provinces of Spain and the southern." Yet the bitterest enmities have arisen between those of common origin and language, and history has called for an inaccessible frontier region and unapproachable boundary

A discussion of the Expansion of Nations, and in particular of the Russian advance in Asia, leads to some interesting but delicate conclusions on the probabilities of the future which should, at present, be treated with reserve. The subject passes naturally into an examination of spheres of influence, buffer states, and protectorates, which is in many ways the most interesting part of the book. The sphere of influence is a boundary in two dimensions, which in modern political practice has superseded the old device of laying waste trans-frontier regions and creating an artificial wilderness. The proclamation by one nation of "a sphere of influence" denotes acknowledged interest in some sphere lying beyond the frontier, of which the advancing power is unable or unwilling to assume control; the proclamation is a warning to trespassers, but without support in law—it is equivalent to a notice "Trespassers will be shot." A one-sided policy, such as that of the Monroe doctrine, admitting of no foreign interference, while binding the government to no responsibility for peace or security, may be disastrous for the sphere of influence, and others' material interests in it, as we have seen in Mexico. The sphere of influence naturally develops into a protectorate, which the author defines as an old device to obtain power without incurring responsibility—though it must be admitted that historical examples of success in the latter respect are not common.

The distinction between a buffer state and a sphere of influence depends upon the nature of the guarantee. A proper buffer state is

expected to preserve its nationality under guarantees from the powers which it separates, while remaining independent of either; neutral states in Europe provide perfect examples of the theory, and of its dangers in practice. Persia, again, is an excellent example of the true buffer state; Afghanistan of the state which is guaranteed by one power only, and is practically a protectorate. Of frontier revisions resulting from the war, none will be more important than those in Persia and Mesopotamia.

The chapter on Military Aspects of a Frontier deals with strategic railways and the care which must be given to their requirements in any future selection of frontiers. From this point of view the author finds the system behind the north-west frontier of India gravely deficient, and makes detailed suggestions for its improvement. An interesting discussion of the present war leads to the not unexpected but very disagreeable conclusion that, where natural barriers are lacking, the frontier must be strengthened with continuous lines of permanent trench and wire entanglement—a prospect very different from the academic view, though not quite irreconcileable with it. The friendly intercourse would take place in "no man's land."

The discussion of natural frontiers covers ground more familiar, but at the same time more immediately interesting to the geographer. "Boundaries are not set up in this world of human ambitions and land hunger for the purpose of assimilating the peoples on either side, or of providing them with suitable accommodation for meeting one another." The ideal of a natural boundary is that no man should be able to cross it and to claim that he was not aware of his crossing. Expense of construction and maintenance are in themselves sufficient to rule out an artificial boundary when a natural can be found; and the argument is strengthened if such boundaries are now to demand lines of continuous fortification.

The geographical problems in boundary delimitation were recently the subject of a lecture before the Society by Sir Thomas Holdich, which will be fresh in the minds of our readers. The principles which govern delimitation being examined, with the aid of 'awful examples,' we pass to the subject of demarcation, which "of all the many functions involved in international frontier settlement is by far the most interesting. To the demarcator belongs the real romance of the work." On this Sir Thomas speaks with unrivalled authority, and we hope that his experiences, set out for us with frank good humour, will receive the respectful attention which they deserve. The dangers of a large slow-moving commission with a strong escort; the less obvious troubles that arise from originally friendly contests in wrestling and tug-of-war between the escorts; and the advantage under certain circumstances in trusting to local guarantee for safe conduct, are interesting points of frontier policy which make this twelfth chapter one of the best in the book.

Principles having been established, we enter in the thirteenth and

fourteenth chapters on a detailed discussion of frontiers in Africa, Asia, and finally Europe, deserving more detailed examination than is possible in this brief notice. The author maintains throughout his thesis that we want barriers, not further facilities for an "over-supply of indigestible aliens whom no government really cares to assimilate." He refuses to "concern himself vainly with the division of the bearskin, which has been parted and parcelled out so frequently already as to leave little more to be said until the bear is actually skinned." But he is able to conclude with a useful examination of what is already well known of the wishes and aspirations of nationalities concerned.

This inadequate notice of a most interesting book will have served its purpose if it calls attention to the need for a straight fight between the two schools of thought—that of the author, who speaks from wide knowledge and experience of what has actually happened on comparatively wild and unsettled frontiers, and that of the academic party, who rely on their interpretation of the history and sentiment of more civilized folk. The "barrier" theory could not be put in more interesting and striking fashion than has been done by Sir Thomas Holdich. We commend it to the appreciation of all who think with him, and to the serious consideration of the opposite camp.

THE CONQUEST OF MEXICO

The True History of the Conquest of New Spain, by Bernal Diaz del Castillo, One of its Conquerors; edited by Genaro Garcia. Translated with Notes by **Alfred Percival Maudslay.** 5 vols. London: Hakluyt Society, 1908–1916. *Price (to members of the Hakluyt Society)* £4.

THOSE who have formed their impression of Bernal Diaz from the quotations given by Prescott will have a pleasant shock of surprise when they turn to Mr. Maudslay's translation lately issued in five volumes by the Hakluyt Society. Prescott, who consulted him very freely, accused him of "vulgar vanity which breaks out with a truly comic ostentation on every page," but he admitted the charm of the work, and thought it due to the spirit of truth which pervades it. When he wrote this criticism he had nothing to work upon but the version of the friar Remon, which as we now know had been wilfully corrupted by the suppression of whole pages and the interpolation of others. It was not until 1904 that an accurate copy of the original MS. in the State Library of Guatemala was published in Mexico by Don Genaro Garcia, and it is from this version that Mr. Maudslay has made his translation. One can hardly imagine a more difficult task for a translator. Bernal Diaz wrote like no one else. He began to write forty years after the event, when he was past seventy, but, owing doubtless to the number of times he had told the story, he had forgotten nothing, not even the names of obscure individuals who played

minor parts in the drama. Lacking the instinct for the picturesque and the skill for literary expression, he set out to recount simply what he saw and heard with all the fidelity and wealth of detail of a photograph. When a historian records what his personages said as well as what they did the reader comes to know their characters as intimately as if he had lived with them. From Diaz we know every *conquistador* as well as we know the neighbours of Samuel Pepys; we should recognize Cortés and Alvarado if we met them in the street, but this feeling is very largely due to the excellence of the translation, which has preserved the rude idiom of the original without sacrificing any of its charm.

Let us, as old Diaz would say, cease talking of the translation and come to the matters which concern geographers—the maps and the notes. For this part of the work Mr. Maudslay was specially equipped by his intimate knowledge of Mexico and by his studies of the Maya monuments in the country traversed by Cortes in his disastrous march to Honduras. He has traced very carefully the routes taken by the Spaniards in their two great expeditions, and has given satisfactory identifications of all the places mentioned in the text. Among the illustrations he gives reproductions of the pictorial title-pages of Herrera, and a fine coloured plate of a native battle piece from the Ball Court Temple Chichen Itza in Yucatan. But his greatest curiosity is a reproduction of the native plan of Mexico City, painted on maguey cloth, which hangs in the National Museum (See also Mr. Maudslay's paper in *G.J.*, July, 1916). Don Manuel Orozco y Berra, the Mexican historian, was unable to accept the plan as representing Mexico City, in spite of the portraits of the kings that adorn its margin. The positions of the old causeways and canals were well known, and they did not appear to coincide with the causeways shown in the Maguey map, nor was the great pyramid temple of Tenochtitlan delineated; but Mr. Maudslay has given good reason for believing that it is the plan of one of the western suburbs, that the last additions to the plan were made about 1562, and that the church marked "Sta Maria" is identical with the church of Santa Maria la Redonda, which was built about 1524, and which still exists. The plan includes about 400 houses, each with its owner seated at his doorway, as well as portraits of the reigning kings, and of Cortes, from 1425 to 1562. The number of years of each reign is shown by blue dots behind each portrait. In the binding case which forms volume 3 are reproductions of the map of the city and lake of Mexico drawn three years after the conquest, and of the MS. map of the city and valley of Mexico drawn by Alonzo de Santa Cruz in the middle of the sixteenth century. Considering the mass of information with which he might have illustrated the text, Mr. Maudslay has shown great self-restraint, for his notes are limited to bare identifications of the persons and places mentioned. He is tempted, however, once to break his rule. At Tayasal Cortés "ordered us to leave at that pueblo a black horse which was ill from the chase after deer, and the fat of its body had melted and it could not stand upright;" Cogolludo, in

his 'History of Yucatan,' 1688, tells us the sequel. Nearly a century later two missionary priests found in one of the temples "a great idol in the form of a horse, made of stone and cement. It was seated on the floor of the temple on its haunches with its hind legs bent under it, raising itself on its forelegs." They had tried to feed the poor beast on chickens and garlands of flowers, and when it died they had worshipped it as the God of the Thunderbolt. "As soon as the padre Fray Juan de Orbita saw the idol it seemed as if the Spirit of Our Lord had descended on him, for, carried away by a fervid zeal for the glory of God, he took a great stone in his hand and battered the statue to pieces." Mr. Maudslay found traces of this tradition nearly three centuries later. We have one criticism to make, and that is that the editor, who so modestly conceals himself under the title of "Translator," owed us more than eighteen pages of introduction. We should have preferred a commentary from his pen to the long extracts from Garcia, good as they are. He agrees with the accepted theory that the Nahuas, the Mexicans of the Conquest, came from the north-west, having arrived from Asia at a period so remote that cereals and iron were unknown; that they drove the more cultured Maya into Guatemala and thence into the limestone plains of Yucatan, where they built the cities whose sculptured ruins are still scattered over the northern part of the peninsula.

It is interesting to find in Bernal Diaz a chapter devoted to the expeditions fitted out by Cortés at his own expense for discoveries in the South Seas. It does not add much to what we know of the expeditions of Sayavedra (1527), Grijalva and Alvarado (1537), and Villalobos (usually dated 1542). According to Diaz' rather confused account the expedition of 1537 came to nothing, because of disputes about the high command, but Villalobos sailed in command of three of the best of the ships in 1538. We know from other sources that two of the ships reached the Moluccas in safety.

The Hakluyt Society is to be congratulated on the completion of this important work on the tercentenary of the death of Richard Hakluyt. It is the most complete, the most truthful and the most human chronicle of an expedition that will live as one of the greatest military adventures in history.

BASIL THOMPSON.

THE CREAGH-OSBORNE COMPASS

MESSRS. H. Hughes & Son (of 59, Fenchurch Street) have recently brought out two pocket compasses which possess some new and interesting features, and have kindly placed at our disposal for exhibition an example of each. They are both constructed from the designs of Captain F. O. Creagh-Osborne, Superintendent of Compasses at the Admiralty, one being especially for the use of Artillery and the other for Infantry. In many respects the

compasses are similar, and consist of a circular metal box containing a mica card and float, on a centre pivot, and moving in spirit. The card is painted black and the degrees are numbered from 0° to 360° in white radium paint to render them visible in the dark, the "0" in every case being omitted for greater clearness in reading. On the top glass of the box is a white radium arrow-line, which serves as the "lubber-line." The metal box of the Artillery pattern measures 2½ inches in diameter and 1 inch in depth, while the diameter of the Infantry pattern is 2¼ inches and its depth ¾ inch. The mica card has a dome-shaped metal centre-piece which projects somewhat above the level of the card, and the whole is so arranged that the weight, instead of being directly on the central vertical pin, as is the case with ordinary compasses, is borne by the liquid. The result is that as the compass is turned in the hand the card practically remains in the same position, or if there is any movement it soon ceases, and the card comes to rest again in a remarkably short time. Tests are stated to have been made with these compasses and with the Army Service Mark VII. Prismatic, and it was found that while, after deflecting the compass through 90°, the latter took 120 seconds to come to rest, in this new pattern liquid compass all movement had ceased in 20 seconds after the same amount of deflection. After all there have been several excellent liquid compasses obtainable for years past, although different in details of construction, and the principal innovation is in the methods of sighting and reading the bearings. These differ in the two patterns. In the Artillery compass, on the top of the box is mounted a rectangular prism, which, instead of being near the eye, is on the opposite side, so that when it is adjusted into position the bearings on the far side of the dial are read instead of those on the side near the eye, as is the case with ordinary prismatic compasses. The face of the prism is curved to act as a magnifier, and in the centre of its upper edge is a radium mark, used for sighting on the object of which the bearing is required. The prism is mounted on a ring which can be moved round the dial; and on the same ring, at the opposite side to the prism, is a hinged pointer which can be raised or lowered, and used when desired for marching on a bearing.

In taking a bearing the compass is held horizontal; and with the pointer lowered, and the prism adjusted so that the figures can be easily read, the ring with the prism is moved round until the lubber-line is seen in a line with the mark on the top of the prism. The object is then sighted and the bearing read off.

The Infantry pattern compass, although similar in some respects, differs from the Artillery pattern in several of its features, the most noteworthy of which is that instead of the bearing being read by a prism placed on the opposite side of the compass to the eye, it is read by means of an adjustable hinged lens on the eye side of the dial. On the opposite side, where the prism is placed in the Artillery pattern, is a hinged pointer with a line of radium paint down the centre. When taking a bearing the movable ring carrying the lens and pointer is revolved until it is in line with the lubber-line on the compass glass, and then when the pointer is raised to a suitable position and directed to the object, the bearing is read off by means of the lens previously adjusted so that the figures can be easily seen. A small section of the upper part of the lens has been cut away to render the object visible; and in order to obtain a more accurate alignment a notch is cut in the top of the metal frame that holds the lens. Both compasses carry a "Verner ring" which can be used for marching on any required bearing, as in the case of the Army Service pattern compass.

The method of reading the bearings through an open prism or lens on the

opposite side of the dial to that at which the eye is placed possesses certain advantages and gives greater facility and rapidity in sighting. Then the marking of the north point 360° and the south 180° instead of the reverse which is the case with the ordinary prismatic in order that the proper bearings may be read, is certainly to be preferred, although even now in the Artillery compass with the prism the figures have to be written the wrong way up. But perhaps one of the greatest improvements in these compasses is that the degrees themselves are marked in radium paint, so that any required bearing can be quickly read at night without the aid of a lamp, which certainly cannot be done with the ordinary pattern compass, even when fitted with luminous marks for setting on a bearing, as in the case of the Army Service pattern.

Still, it must be admitted that there is a certain lack of refinement with these compasses, and the bearings cannot be read with any great accuracy. In the first place the Infantry compass is only marked to 5°, while on the Artillery pattern, which is the more accurate of the two in this respect, only every second degree is given, so that readings to a degree can only be obtained by estimation, which is not at all easy. The sighting arrangements are certainly not likely to give such accurate results as those obtainable by the fine line or vertical thread of an ordinary prismatic compass, and there is frequent difficulty, especially with the Artillery pattern, in taking bearings of an object at any considerable altitude.

These are matters that could be improved, and later on doubtless they will be; but perhaps after all, if the well-known Army Service pattern compass floating in liquid, which has proved most excellent for cavalry and other work, could be illuminated with radium paint so that the degrees and sighting line could be read in the dark, it might be found to give bearings that would compare very favourably with those to be obtained with these new compasses.

E. A. R.

REVIEWS

AMERICA

David Thompson's Narrative of his Explorations in Western America, 1784–1812, edited by **J. B. Tyrrell.** Toronto: The Champlain Society. 1916. Pp. xcviii., 582. *Illustrations and Maps.*

ELLIOTT COUES' wish, expressed in 1897, that this MS. might one day "appear under Mr. Tyrrell's very competent editorship," has at length been fulfilled. Its publication in such handsome form does credit both to the editor and to the Champlain Society. On Thompson's death in 1857 the MS. was purchased from one of his sons by Mr. Charles Lindsey of Toronto, who about 1890 disposed of it to Mr. Tyrrell. As Coues stated, none was in a better position to edit this MS. than its present owner. "In pursuit of my work as a geologist," writes Mr. Tyrrell, "it was my good fortune to travel for many thousands of miles over the same routes that Thompson had travelled a century before, to camp on his old camping-grounds, and to take observations on the very spots where he had observed" (pp. xxxii. and xix.). Mr. Tyrrell has been able therefore not only to control Thompson's narrative at every turn, but also to illustrate it with photographs of a number of the places mentioned. These add very greatly to the reader's enjoyment.

From the year 1784 when, aged only fourteen, he first reached Churchill, until his death at Longueil near Montreal in 1857, David Thompson had

travelled through more than 50,000 miles of unmapped country. His surveys, far from being rough sketches, consisted of "careful traverses made by a master in the art" (p. lx.). Consequently Mr. Tyrrell "everywhere found Thompson's work to be of the very highest order" (p. xix.). "His surveys and observations were invariably found to have an accuracy that left little or nothing to be desired" (p. xxxii.). Thompson, for instance, placed Cumberland House in lat. 53° 56′ 44″ N. and long. 102° 13′ W., "a position almost identical with that which it occupies to-day on the latest official maps" (p. xxxi.). On p. lxi. the editor gives the longitude of ten places mentioned by Thompson, whose greatest error is less than ten minutes—truly a remarkable achievement. It should be remembered also that at many of these points Thompson was breaking completely new ground.

When Mr. Tyrrell in 1896 wished to explore the so-called "Muskrat country," "the only map of any service which was available was that drawn in 1813 by David Thompson" (p. lxxxv.). Thompson's great map, portions of which were published by Coues, is here reproduced in full, and clearly justifies the description given by Coues of Thompson as "the greatest geographer of his day in British America."

Thompson's 'Narrative,' a few pages of which have unfortunately been lost (pp. 365, 369, and 533), is divided into two parts, the first of which describes the lands to the east of the Rockies, the second those on the west side of this great chain. Thompson's description in Part I. of the Indians of the Plains is most realistic, and will form a most valuable addition to the literature on this subject. According to Dr. Bigsby, Thompson's colleague in 1817 on the International Boundary Commission, the latter could "create a wilderness and people it with warring savages, or climb the Rocky Mountains with you in a snowstorm so clearly and palpably, that only shut your eyes and you heard the crack of the rifle or felt the snowflakes on your cheeks as he talked" (p. lvi.). The same impression of reality breathes from every line of this narrative.

The narrative also contains valuable historical information, such, for instance, as the first use of horses by the Snake Indians, and the sight of these horses in early days by the Blackfeet. Thompson at times foretold the future of the districts he explored with some accuracy; but his opinion has turned out false, that the "great Plains appear to be given by Providence to the Red men for ever, as the wilds and sands of Africa are given to the Arabians" (*sic*) (p. 241).

In Part II. Thompson describes his journey to the mouth of the Columbia, which forms one of the most interesting episodes in the 'Narrative.' His treatment of the Indians along the banks of this river, which he knew he must again ascend, showed great wisdom and foresight.

Thompson resembles in many ways his great predecessor Champlain. Both were religious men, who knew the Indians well, and handled them with consummate skill. Both again looked upon the fur trade merely as a means to further exploration of the country wherein lay their main interest. So close is the resemblance of the narratives of these men that, in reading Thompson's MS., one frequently imagines one is reading an English version of Champlain. It is interesting to note that Champlain died at Quebec a comparatively unknown man in 1635, and two hundred years later David Thompson, one of Canada's greatest sons, was buried in an unknown grave in Montreal. Canada, then, like older countries, has sometimes failed to honour her great sons.

In one respect the editing of this volume has been overdone. Each time the word "goose" occurs in the narrative the scientific name is added in

a note. The same is done for "wolf," "deer," etc. One such reference would have been sufficient. Again, the note on p. 169 merely states what is set out in the 'Narrative' itself on p. 177. So again on p. 455 the note repeats what is stated in the text on the previous page. The word on the first line of p. 40 should surely be *badly*, not *sadly*?

H. P. B.

GENERAL

The Mechanical Star Bearing-Finder. A Simple Pocket Guide for Night Marching.— E. T. Goldsmith, R.N. London: George Philip & Son, Ltd. [1916.] *Price 5s. net. Presented by the Publishers.*

Several attempts have been made lately to simplify the finding of bearings of stars with a view to their more general use for marching at night during military operations. Some of these consist of pocket-books of tables giving the bearings for different times and latitudes, whilst others are movable diagrams or mechanical contrivances of a more or less useful nature. The most recent of the latter is "The Mechanical Star Bearing-Finder," devised by Mr. E. T. Goldsmith, R.N., Senior Naval Instructor, Royal Naval College, Keyham, which has just been published by Messrs. G. Philip & Son.

Upon a strip of linen, measuring about 3½ by 13½ inches, are shown, in their relative positions, the most suitable stars for marching purposes in the South of England and the North of France, and on a line running along the bottom of this star-map are the months and days. This strip-like linen star-map is made to slide along in a mounted cardboard cover, upon the lower edge of which are given the hours of the day and night. Next there is a transparent celluloid protractor upon which curves are drawn giving the bearings of any of the stars seen on the chart through the protractor, when the latter is set for any time by means of a suitable pointer.

In using this contrivance for finding the bearings of stars, first the star chart is moved along until the date is in a line with one of the edges of the time scale at the bottom of the outer cover, and then the celluloid bearing protractor on the top of the star chart is placed so that an arrow in its centre is opposite the time for which the bearing is required. When this is done the bearing of any star on the star-map that is visible through the celluloid protractor can with care be read off to within a degree or two. Allowance has been made for "variation," so that the bearings read off the protractor are magnetic and not true bearings, as is usually the case with devices of this sort. It seems doubtful if this is an advantage, especially as the variation is not the same for the south of England as for northern France, and is changing every year. By a simple arrangement for giving the proper declination of the sun, the same protractor can be used for finding the bearing of the sun for any date and time. Additional protractors are in preparation for use in other areas, of which those for the south of Scotland and the north of England are now ready.

There is no doubt that this device is ingenious, but how far it will prove of practical utility for the purpose of star marching remains to be seen. Since the time must be known, it is also a question whether a set of pocket tables prepared for the same stars and limits of latitudes, giving the bearings for every degree at definite times would not have been of more service, handier to use, and have given greater accuracy.

In the explanatory text there are one or two mistakes in the spelling of star names that might be corrected in another edition; for instance Fomalhaut is spelt Formalhaut, and α Ophiuchi is given as a Opiuchi.

E. A. R.

Philip's New Pocket Planisphere, showing the Principal Stars visible for every hour of the year. London: George Philip & Son, Ltd. 1916. *Price 1s. 6d. net. Presented by the Publishers.*

Philip's Planisphere for the latitude of London is well known, and for years past has proved useful to those wishing to learn the stars, and ascertain their position at any time. So far it has been made with discs of 10 inches diameter, but an edition has recently been published reduced to half this size, which certainly has the advantage of being more portable. It is generally similar in design to the larger pattern, but owing to the reduction is not quite so clear or easily read. Still it will doubtless be welcomed by many, especially those to whom portability is of considerable importance. Although apparently constructed for the latitude of London the planisphere is sufficiently accurate for several degrees on either side of this latitude; but it is misleading to state, as is done on the leaflet that accompanies it, that it is for the Northern Hemisphere, since there are many latitudes in the Northern Hemisphere where it would be of no use at all.

E. A. R.

Essentials of Geography.— Albert Perry Brigham, A.M., and **Charles T. McFarlane, Ph.D.** New York, Cincinnati, Chicago: American Book Company. First Book, pp. vi., 266; Second Book, pp. vi., 426.

These school-books are in the well-known American form—quarto, with numerous maps and illustrations, both coloured and uncoloured. Though called First Book and Second Book, the second is not supplementary to the first. They both cover largely the same ground. Both give the geography of the world by continents and countries, with a large proportion of the whole devoted to the United States. The First Book, for example, gives seventy-four pages to the United States, and only four to Canada and Newfoundland. But the Second Book is fuller in its information and of a higher standard. There are some curious differences in the arrangement of the two books, and curious omissions in the Second Book of subjects dealt with in the First. Thus, in the First Book a section on "The Earth as a Whole," in which the form and rotation of the Earth, the finding of direction, land and climate, and maps are treated of, comes immediately after the first section entitled "How People Work and Live," while the corresponding section in the Second Book comes immediately before the appendix and omits the paragraphs on maps: all that is said on that subject is put in this volume under the United States, where there are a few paragraphs on "Ways of Showing the Forms of the Land." In the Second Book there is nothing on the general subject of government corresponding to what we find at the end of the first section in the First Book.

In text and illustrations both volumes are excellent—accurate and clear and the matter well selected. Wherever opportunity offers, especially in the Second Book, where geography is defined (p. 5) as "the study of the Earth and its products, of man and his industries, and of their influence upon each other," geographical explanations of the facts mentioned or illustrated are introduced, and one has only to regret that the limits imposed on the works do not allow of this being done more frequently and fully. This leads one to ask whether after all it would not be better educationally to restrict the range of one's outlook, or at least to treat the greater part of the world on very broad lines, and to deal much more fully with some comparatively small area. This is not offered as a criticism of either of these books, for of course text-books must

be adapted to the system of teaching actually in use; but our observation is due to the fact that both in the text and the maps these volumes suggest many more questions as to geographical influence than could be answered without greatly increasing the number of pages, probably more questions than any geographer would undertake to answer at all. With regard to some of the various distributions so clearly stated, one would like to have such a full examination as would show how far those distributions are due to influences connected with place, how far to organization that might be carried on in any place or at least in many places. It is this full treatment that might be expected to beget in the young the geographical habit of mind. It is this kind of treatment, it may be added, that is involved in the practical application of geography, the application that decides those who have the command of capital in laying money out here rather than there. In such cases, as appears from the very terms of one statement, it is geography that takes account of all the factors existing at any time, including human factors of many kinds. If the wielders of capital are powerful enough to influence even governments in their favour, that also will be considered, but that also belongs to the geography of the time—the geography of the concession hunter.

Both volumes are provided with an index in which the pronunciation of proper and many other names is indicated. From these lists English readers may be interested to learn that the American towns of Gloucester and Worcester are both pronounced with the accent on the second syllable.

G. G. C.

THE MONTHLY RECORD

EUROPE

After-Shocks of the Avezzano Earthquake of 13 January 1915.

This great earthquake occurred at 7.30 a.m., and for more than an hour afterwards the ground was agitated so continuously that the individual shocks could with difficulty be distinguished. Dr. A. Cavasino has published a catalogue of all the after-shocks recorded at the Rocca di Papa observatory during the first six months in the *Bollettino* of the Italian Seismological Society (vol. 19, pp. 219–291). Though the observatory is not less than 40 miles from the epicentre of the earthquake, the numbers of shocks recorded during the first two days were 302 and 126. After this they diminished rapidly in frequency, though not, it appears, in accordance with Omori's law. During the first six months the total number was 1280, most of them very slight tremors, for only 37 were strong enough to be felt at Rocca di Papa.

Forest Destruction in the Mediterranean Basin.

The old question of the extent to which a former forest-covering in the lands bordering the Mediterranean on the north has been destroyed by the agency of man is once more discussed by a German writer, Dr. H. von Trotta-Treyden, in the July and August numbers of *Petermanns Mitteilungen* for 1916. Few will deny that the lands in question were once far better covered with forests than at present, though opinions differ as to the extent of the change, and still more so on the more difficult question of a possible change of climate resulting from the loss of the forests. This latter subject is wisely left on one side by the writer. He begins by bringing together from the statements of classical writers

the evidence for the former existence of forests where now the landscape is bare and desolate, in parts of Greece, Italy, Spain, etc., afterwards paying attention to the causes of forest-destruction in the need of wood for fuel, house and ship-building, and so forth, and its unfortunate results. Of the last there can hardly be two opinions, as there is now general recognition of the effects of forest-destruction in causing excessive denudation with loss of humus, the alternation of disastrous floods with insufficient water-supply in streams, and the failure of springs. The economic effects—consisting in the diminished supply of fuel, the destruction of wild game and other animal life, and the secondary effects on agriculture due to the primary physical effects, are also obvious. The writer considers forest-destruction to be definitely related with the decline in civilization manifest in so many of the countries where it has had play, and endeavours to trace the course of such decline in the countries which have made no effort to conserve their forests. It would hardly be safe, however, to emphasize this cause of decline to the exclusion of all others. A useful section is that in which the present character and extent of forests in Mediterranean countries is set forth in some detail. Nowhere do the forests cover any large extent of ground, being in many parts restricted to the higher slopes of mountains. They are marked by the relative thinness of the stand of timber, its stunted character, and the hardness of the foliage. No encouragement is given to the hope that re-forestation may be possible, it being held that in a region placed climatically on the margin of the forest zone rehabilitation is impossible when once the forests are destroyed and the layer of humus is lost. All that can be done, it is held, is to protect the existing forests as far as possible. A map will eventually be supplied, but is held back under the orders of the German censorship.

ASIA

Cyclonic Rainfall in Japan.

A paper on the "Distribution of Cyclonic Precipitation in Japan," under the joint authorship of Torahiko Terada, Takezô Yokota, and Syôhu Otuki, is contributed to the *Journal* of the College of Science, Imperial University of Tokyo, vol. 37, Art. 4, 1916. This is a study, not as the title might suggest of the mean annual distribution over the country of rainfall having a cyclonic origin, but of the mean distribution of rainfall in different parts of a cyclonic system as affected by the local configuration of land and water. On the basis of statistical data the authors show cartographically the probability of precipitation in different districts for different positions of a cyclonic depression. On these lines two sets of charts are produced, showing (1) the curves of equal expectation of rainfall (isohyets) corresponding to each given position of a cyclonic centre, and (2) the curves showing the locus of the positions of a cyclonic centre bringing equal expectation of rainfall for each given district. The isohyetal curves show that in front of a distant cyclone the Pacific coast has greater expectation of rain than the Japan Sea coast, and less when the islands are on the rear side of a cyclone. Another feature shown is that with a cyclone centre in the Japan Sea inland districts of the main island have a smaller expectation than those along either the Pacific or Japan Sea coasts, the reason being ascribed to the "rain shadow" influence of the mountain range lying on the windward side in enhancing the ascending currents of air on the Pacific coast, with consequent condensation of moisture. From the "centre loci" curves it is apparent that the greatest expectation of rainfall prevails in the west, south-west, or south part of the district in question, or in other words, the east, north-eastern, or northern part of a cyclone. Some prominence is given at the

end of the paper to the conclusions of other meteorologists concerning the wettest quarter of a barometric depression. Thus Hann is quoted as attributing most abundant rain to the rear side of a depression in the region north of the Alps, and Mill to the left side of the track of the centre of cyclones crossing Great Britain. The Japanese authors seek to explain these anomalous conclusions on the ground of orographic and other external influences upon the air currents circulating in a cyclonic system, and no doubt such may sometimes enter as factors into the total result. Dr. Mill, however, finds his rule to hold not only in the common instances of large barometric depressions taking an easterly course across the British Islands, but also in the less frequent cases of small rainy depressions taking a slow irregular course over the country. In all these cases the heaviest precipitation is confined to the left side of the cyclonic path, a circumstance which indicates that the relative distribution of precipitation in the different segments of a cyclone is affected by internal factors. The reason was discussed in *Symons' Meteorological Magazine* for June 1911 by Mr. R. Corless, who showed that in the left half of a travelling cyclone the ascending motion conducive to precipitation should be more pronounced than in the right.

AFRICA

A North African "Shott."

The *shotts* of North Africa are known to geographers as saline basins, with no outlet to the sea, the floors of which are sometimes covered (after rain) with a shallow layer of water, but form in general an almost impassable quagmire, neither water nor land. The Shott Tigri, on the borders of Algeria and Morocco, which is the subject of a special study by Prof. E. F. Gautier in the *Annales de Géographie* (May and July 1916), is not properly a shott as understood by the Arabs (who speak of it simply as the Tigri), for its floor is largely composed of firm ground, though dotted over with numberless small swampy depressions, besides a larger central one which receives the scanty drainage of the basin. As a whole this resembles the other shotts in possessing the form of a closed basin, which is almost entirely shut in by more or less steep escarpments. M. Gautier's study is based partly on the French official map, which he reproduces with some modifications intended to bring out more clearly the morphology of the basin, and partly on a detailed study on the ground of a portion of the whole, which he represents on a larger scale. While of interest in connection with the general evolution of the surface forms in a region of progressive desiccation, the Tigri possesses noteworthy special features of its own. The height and continuity of the surrounding escarpments separate it from the shotts further east, though these features are more typical of the other western shotts. The drainage basin is marked by its comparatively small extent, being almost limited by the crests of the surrounding escarpments, from which the weds find their way north and south over the surface of the surrounding plateaus. M. Gautier finds traces of river capture which seem to have reduced the drainage area of the Tigri in course of time. Within the cliff boundary the surface is of a chaotic form characteristic of desert erosion. Much consists of a sea of sandy bosses known as *nebkas*, differing from dunes in form and in being crowned by a tuft of vegetation, to which in fact they owe their origin in the accumulation of the sand. Partly masked by the sand M. Gautier found unmistakable traces of former river-erosion, though the continuity and consistent fall of the old channels have been lost through wind-action, which has removed the alluvium from the softer portions and left the channels formed in the harder strata. These old stream-beds help to reconstruct the former drainage system. A point of

difference from other shotts is the slight amount of salt present, and the resulting vegetation-cover in the individual depressions, which from this fact are rather *dayas* than shotts. The escarpments, to which erosion is now practically limited, offer some interesting problems, one being the presence of what might be termed hanging valleys. These seem to prove that the level of the floor of the basin has been lowered by the removal of the alluvium by the wind. From a study of geological evidence (including traces of volcanic action discovered by him) M. Gautier concludes that a closed basin has existed here possibly since the close of the Cretaceous period, but that it has taken its present form as the result of subsidence in Pliocene times, accompanied by volcanic eruptions.

AMERICA

The Ice Age in North America.

In a communication of some length sent to us from Philadelphia, Pa., and accompanied by photographs taken by him, Mr. Hiram W. Hickson calls attention to the high terraces fringing the southern side of Fairbank Lake, Ontario, which appear to have been formed when the lake was dammed by the edge of a retreating ice-sheet during the later stages of the Glacial Period. Mr. Hickson considers that the breadth of these terraces implies a lengthy period of erosion, and shows that the retreat of the ice was very slow. He is inclined to think that the shrinkage of the ice-sheet from its farthest limits to its disappearance may have taken a very much longer time than is usually supposed.

New York City and State.

The issue of the *Geographical Review* for September 1916 is largely occupied with papers on the geography of New York City and State as affecting the life and distribution of their inhabitants. The first, by Prof. Ellsworth Huntington, emphasizes the influence on the growth and development of New York of its water barriers, which cut off the original nucleus of settlement on Manhattan Island from its natural expansion, and involved the partial conquest of nature by means of ferries, bridges, and tunnels, at an enormous expenditure of energy and capital. These barriers have greatly exaggerated the congestion found in any city. Prof. Huntington puts the result of his study somewhat paradoxically when he says that in their efforts to overcome nature the people of New York have made themselves a hundred times more subject to it, pointing to the greatly increased harm that would be done to such a city as New York by a convulsion of nature, by the very reason of its elaborate developments of human industry. He also draws a moral in pointing to the disastrous results of possible decadence which might relax "our grip on nature and ourselves." In the next paper Mr. E. P. Goodrich deals with "Some geographic problems incident to the growth of New York City"—a somewhat misleading title, for while treating in an interesting way of many of the problems of traffic, etc., to be considered by those responsible for the welfare of the city, the paper is little concerned with the working of strictly geographical influences. The third paper, by Prof. A. P. Brigham, treats of the growth and distribution of the population of New York State, and here the influence of geographical conditions is well brought out. Interesting comparisons are made with other States of the Union as regards the density and occupations of the population and the curves of increase through a number of years. Neither in the more densely populated area in the south-east, closely in touch with the capital, nor in the agricultural area in the west, need New York fear comparison with neighbouring States. Eight counties in the north-west are comparable with Connecticut as regards

area and density; but while 89·7 per cent. of the population of the former is urban, in the New York region—one of rich arable land—the urban population is only 55·4 per cent. New York shows a consistently progressive increase in population during the period for which statistics are available, corresponding in this respect with Massachusetts, and surpassing typical states chosen from other parts of the Union. A series of instructive maps shows the distribution of population within New York State from the points of view of altitude, soil, transport facilities, and physiography. Over 97 per cent. of the whole *city* population lives below 600 feet, in an area only one-fourth of the whole state, and over 79 per cent. of the *total* population dwells in twenty-six counties occupying only 30 per cent. of the whole area, but forming a belt of low altitude, lake and river soils, and favourable transportation. Whilst four counties occupying the Ontario Lake plains have a density of 209 per square mile, the Adirondacks have one of only 10. Summing up, Prof. Brigham remarks that in a large fraction of the State people live closer together than in any other equal area in the western hemisphere. Her growth in recent years contradicts the notion that only the West is alive. Population is growing, not only in the cities but in the adjoining agricultural areas, where the possibilities of soil and climate are being brought out by intensive tillage.

AUSTRALASIA AND OCEANIC ISLANDS

Geological History of Oceania.

A paper on this subject was read before the National Academy at Washington in April last by Mr. Charles Schuchert under the title "The Problem of Continental Fracturing and Diastrophism in Oceanica," and has since been printed in the *American Journal of Science* (August 1916). The perennial question of the permanence or otherwise of ocean basins takes a prominent place in the discussion, the author holding that too much stress may be laid on such permanence, and that the evidence from Australasia tends rather in the opposite direction. Allowing that the continents are in the main permanent, he considers that they are partially breaking down into the oceanic basins, which, with the periodic shrinking of the Earth and the constantly increasing hydrosphere (owing to the bringing up of "juvenile" water from the depths) are in the main being deepened and enlarged. In the Pacific the postulated subsidence of the floor has on the one hand led to the break-up of the old Australasian continent (the eastern edge of which is marked, like that of Asia, by a series of deep depressions or "foredeeps"), and on the other to the subsidence of the area occupied by the "Oceanides" or island chains of Polynesia. The old continent must have measured some 2200 miles by 1800, and the crustal unrest by which its eastern half was eventually in great part submerged is indicated by the two ancient geosynclines running through Tasmania and New Zealand, which were frequently the theatre of folding and uplift; and by the evidences of past volcanic activity. In the Pacific proper the subsidence during the Mesozoic and Cainozoic ages was accompanied by the formation of parallel ridges as a result of folding and the piling up of volcanic material. In spite of the general subsidence the submerged ridges would be built up and the relief accentuated by the accumulation of organic débris. Mr. Schuchert refers to objections which have been raised to the idea of continental fracturing on a large scale on the score of its inconsistency with the isostatic equilibrium of the Earth's crust; but only to dismiss them as without force. The paper is no doubt largely speculative, but may be useful as emphasizing the imperfect nature of our knowledge of the contours of the Pacific and the need for further

investigation, such as is contemplated by the leaders of the new movement in that direction in the United States.

A Recent Visit to Tristan da Cunha.

Mr. R. P. Houston, in a letter printed in the *Times* of 14 November 1916, gave an interesting account of a recent visit by one of his steamers to the remote island of Tristan da Cunha, whose scanty population—102 in all—lives in as complete isolation from the rest of the world as that of any fragment of the British Empire. Lying as it does off the usual tracks of vessels it is but rarely that they are in communication with the rest of the world, though supplies are taken to the islanders at considerable intervals by ships of H.M. Navy. The islanders are a sturdy and hardy race of people, but education is almost entirely neglected, and Mr. Houston urges that something should be done to remedy this deficiency. The people rear bullocks, sheep, and geese, and grow potatoes, and in former days relied upon chance opportunities of supplying passing ships with these products to obtain the necessary supplies of flour, biscuits, clothing, etc. With the increasing use of steam the number of vessels calling at the island has been greatly reduced, and the stock of necessaries had fallen very low at the time of the visit described. Generous assistance was given, so far as was possible, by the captain and crew of the steamer, but Mr. Houston appeals to the owners of ships to make an effort to help the islanders more than has been the case in the past. The men are expert and fearless boatmen, but possess only two frail boats, made of canvas over a wooden framework, and the acquisition of a whale or surf-boat would be an immense boon. A copy of the current signal code is also much needed. The eldest son of Mr. Glass (the recognized head of the small community) was eager to come to England to enlist for the war, but as the ship was not bound for a British port his wish could not be gratified.

POLAR REGIONS

Scientific Results of the Australasian Antarctic Expedition, 1911–14.

We are pleased to learn from Sir Douglas Mawson that in spite of difficulties, financial and other, due to the war, it has now been possible to arrange for the gradual publication of the scientific results of this expedition, thanks to the help generously offered by the Governments of South Australia and New South Wales. The former has agreed to carry out the printing at the Government Printing Office, Adelaide, and the latter to see to the reproduction of certain illustrative matter. The work will appear in royal quarto, similar to the like publications of other British Antarctic expeditions, and when complete will run to a number of volumes, the printing and publication of which must occupy several years. It is proposed to divide the subject-matter into three series as follows: (A) Geography, Geology, etc.; (B) Physical subjects; (C) Biology; each being subdivided into volumes and parts. Series C is being edited by Prof. W. A. Haswell of Sydney University, who organized the biological programme of the expedition, and of this three parts, dealing with Fishes, Mollusca, and Cephalopoda, are expected to appear almost immediately.

GENERAL

Smithsonian Explorations in 1915.

The Smithsonian Institution is constantly sending out or supporting expeditions for scientific research in various parts of the world, and publishes an annual summary of their proceedings. The greater number are devoted to the

collection of geological and Natural History specimens for the United States National Museum, but as the collectors frequently visit out-of-the-way regions their work has some geographical interest, apart from its value as throwing new light on the distribution of plants and animals. The summary for 1915 (*Smiths. Misc. Collns.*, vol. **66**, No. 3) is profusely illustrated by photographs taken by the travellers, many of them instructive from the point of view of physiography. Those accompanying a report by Dr. Charles D. Walcott, secretary of the Smithsonian Institution, on researches in the Yellowstone National Park, are particularly striking. Geographically, the most interesting report is that of a visit to the basin of the Kolyma River, in the far north-east of Siberia, by Mr. B. Alexander, who, in 1914–15, took advantage of the despatch of a commercial expedition to that region under Captain Koren to carry out a search for the remains of large extinct mammals—particularly the mammoth. Though no complete skeleton was found, a considerable quantity of fossil bones were collected from the raised silt-banks which border the course of the Great and Little Anyui Rivers, two of the largest tributaries of the Kolyma, which approaches the Yukon of Alaska in size. Mr. Alexander saw much that recalled Alaska in the country visited, both in the tundra covered with dense willow thickets and puny larches, and in the nature of the river-banks. The Little Anyui (of which the Great Anyui was found to be almost an exact counterpart) forms enormous bends through the cutting away of the unconsolidated alluvium of the outer banks and the deposit of material as extensive bars on the inner curves. These bars are covered with piles of driftwood, including birches and poplars from the upper reaches. All the fossils collected were apparently of a late Pleistocene age, as many of the bones closely resemble those of species now living. Collections of existing forms were made in the same region by Mr. Copley Amory, and furnish a useful comparison between related Asiatic and American forms. The skull and antlers of an East Siberian moose figured in the report show a close resemblance to those of the American. Another report deals with investigations by Dr. J. N. Rose of the Cactus flora of Brazil and Argentina, which showed that distinctly semi-arid conditions prevail in various parts, *e.g.* in the north of the state of Bahia, where a typical cactus desert was met with, resembling in a remarkable way the deserts of the West Indies. Although the region is traversed by the large and perennial Rio São Francisco, no attempt is made to utilize this for irrigation. Archæological and ethnological researches in the United States are also dealt with at some length.

London University Diploma in Geography.

The wording of a paragraph in the November number of the *Geographical Journal* (p. 435) on the recent establishment of a diploma in geography at the University of London may give the erroneous impression that the candidates mentioned as having taken the diploma were students exclusively of University College. We are asked to point out that courses of instruction in Regional and Historical Geography and in Map-work suitable for the diploma candidates are given also at the London School of Economics, under the direction of Mr. Mackinder, Reader in Geography in the University of London. But these candidates take their courses in the Physical Basis of Geography and in the Use of Instruments at University College. The prospectus of the instruction both at University College and at the London School of Economics may be seen on the Notice Board of the Society's house.

GEOGRAPHICAL LITERATURE: ADDITIONS TO THE LIBRARY

Edward Heawood, Librarian, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are as a rule written in full :—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Gen. = Genootschap.
Ges. = Gesellschaft.
I. = Institute, Institution.
Int. = International.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
Jber. = Jahresbericht.
k.(k.) = kaiserlich (und königlich).
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (Mét.) = Meteorological.
P. = Proceedings.
R. = Royal, Reale, etc.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab, etc.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE

France—Brittany—Coast. **Gadeceau.**
B.I. Océanographique (No. 321), 1916 : pp. 8.
Les forêts submergées de Belle-Ile-en-mer. Par Émile Gadeceau. *Map.*

France—Grenoble—Geology. **Blanchard.**
Recueil trav. I.G. Alpine (*Univ. Grenoble*) 4 (1916) : 237–257.
Le verrou glaciaire de Grenoble. Par Raoul Blanchard. *Illustrations.*

France—South Coast—Economic. *Ann. G.* 25 (1916) : 241–262. **Foncin.**
La culture et le commerce des fleurs et primeurs sur la Côte d'Azur, de Toulon á Menton. Par Myriem Foncin.

France—Val de Réchy. **Lencewicz.**
La transhumance dans le Val de Réchy. By Stanislas Lencewicz. (*Extr. Bull. Soc. Neuchâteloise de Geogr.*, 1916.) Neuchatel, 1916. Size 9 × 6, pp. 17. *Illustrations and Map.*

Germany—Alsace-Lorraine. *Petermanns M.* 62 (1916) : 121–127. **Paulin.**
Die Ortsnamenverdeutschung in Elsass-Lothringen. Von Peter Paulin.

Italia Irredenta—Place-names. **Maranelli.**
Carlo Maranelli. Dizionario geografico dell' Alto Adige, del Trentino, della Venezia Giulia e della Dalmazia. Bari : G. Laterza & Figli, 1915. Size 9½ × 6½, pp. viii. and 214. *Price* 3*s.* 6*d.*

Italy—Anthropogeography. **Arbos.**
Recueil trav. I.G. Alpine (*Univ. Grenoble*) 4 (1916) : 259–274.
Etudes sur l'habitat de montagne en Italie. Par Ph. Arbos.

Italy—Gargáno—Morphology. **Checchia-Rispoli.**
La G. (*Novara*) 4 (1916) : 255–259.
I terrazzi delle pendici meridionali del Gargáno. By G. Checchia-Rispoli. *Map.*

Italy—Islands. *Mem. G.* (1916) : 223–284. **Anfossi.**
Studi orometrici. III. Volumetria dell isole minori italiane. By G. Anfossi. *Illustrations.*

Italy—Po Basin—Hydrography. *La G.* (*Novara*) 4 (1916): 205-225. **Anfossi.**
Sul regime dei corsi d'acqua nel bacino padano. By Giovanni Anfossi. *Illustrations and Sketch-maps.*

Italy—Po Valley. **Bénévent.**
Recueil trav. I.G. Alpine (*Univ. Grenoble*) 4 (1916): 189-236.
La plaine du Pô. Etude de géographie humaine d'après le livre de M. Arrigo Lorenzi. Par E. Bénévent. *Sketch-map.*

Italy—Study of Geography. *Scottish G. Mag.* 32 (1916): 401-406. **Chisholm.**
Geography in Italy. By George G. Chisholm.

Poland—Political. ———
Poland's case for independence, being a series of essays illustrating the continuance of her National Life. Published for the Polish Information Committee. London: Allen & Unwin, 1916. Size 9 × 5½, pp. 352. *Price 7s. 6d. net. Presented.*

Scandinavia—Historical. **Stefansson.**
Denmark and Sweden with Iceland and Finland. By Dr. Jon. Stefansson. With a preface by Viscount Bryce. (The Story of the Nations.) London: T. Fisher Unwin, 1616. Size 8 × 5½, pp. xxxii. and 384. *Map and Illustrations. Price 5s. net. Presented.*

ASIA

Ceylon—Archæology. **Mitton.**
The lost cities of Ceylon. By G. E. Mitton. London: John Murray, 1916. Size 9 × 5½, pp. xvi. and 256. *Map and Illustrations. Price 10s. 6d. net. Presented.*
A good popular account of these ruins, though the illustrations hardly do justice to their marvels.

China. **Richard.**
Forty-five years in China. Reminiscences by Dr. Timothy Richard. London: T. Fisher Unwin, [1916]. Size 9 × 5½, pp. 384. *Illustrations. Price 10s. 6d. net. Presented.*

China—Historical. *T'Oung Pao* 16 (1915): 515-561. **Cordier.**
Mélanges géographiques et historiques. Manuscrit inédit du Père A. Gaubil, S.J. Publié avec des notes par Henri Cordier.
Père Gaubil discusses various questions touching the topography of the interior of the Chinese Empire as known to the Jesuits in the early eighteenth century. Previous notes from the same MS. had already been printed in the same serial.

China—Historical. *T'Oung Pao* 16 (1915): 575-603. **Cordier.**
Origines des Chinois. Théories étrangères. Par Henri Cordier.

China—Hwang-ho. *Z. Ges. E. Berlin* (1916): 79-94. **Herrmann.**
Der Hwang-ho. Versuch einer Monographie nach Filchners und Tafels Forschungen. Von Albert Herrmann.

China—Sechuan. *J. North China Branch R. Asiatic S.* 47 (1916): 39-48. **Ward.**
Notes on the flora of the West Ssüch'uan Mountains. By F. Kingdon Ward.

China—Western—Geology. **Legendre.**
Mission A. F. Legendre. Massif Sino-Thibétain. Provinces du Setchouen, du Yunnan et Marches Thibétaines. Contribution à l'étude géologique de ce massif. Préface de Charles Rabot. Paris: E. Larose, 1916. Size 10 × 6½, pp. iv. and 250. *Maps and Illustrations. Price 12s. 6d.*

China—Zoology. *J. North China Branch R. Asiatic S.* 47 (1916): 53-82. **Sowerby.**
Recent research upon the mammalia of North China. By Arthur de Carle Sowerby.

French Indochina—Fishery. **Guilbert.**
B. Economique Indochine, N.S. 19 (1916): 133-191.
La pêche dans le golfe du Tonkin. By L. Guilbert. *Maps and Illustrations.*

Himalayas—Orography. *G.Z.* 22 (1916): 249-269. **Schmitthenner.**
Der Himalaja. Eine orographische Skizze. Von Heinrich Schmitthenner. *Illustration.*

India—Bombay—Hot springs. **Mann and Paranjpye.**
J. Bombay Branch R. Asiatic S. 24 (1916): 185-212.
The hot springs of the Ratnagiri District. By Harold H. Mann and S. R. Paranjpye. *Maps.*

India—Historical. **Roberts.**

A historical geography of the British Dependencies. Vol. 7. India. Part I. History to the end of the East India Company. By P. E. Roberts. Oxford: Clarendon Press, 1916. Size 7½ × 5, pp. 416. *Sketch-maps. Price 6s. 6d. Presented.*

India—Nepal. **Vansittart and Nicolay.**

Handbooks for the Indian Army. Gurkhās . . . By Lt.-Col. Eden Vansittart. Revised by Major B. U. Nicolay. Calcutta, 1915. Size 10 × 7, pp. iv. and 232. *Map. Presented.*

Japan. **D'Autremer.**

The Japanese Empire and its economic conditions. By Joseph D'Autremer. Translated from the French. London: T. Fisher Unwin, 1915. Size 8 × 5, pp. 320. *Map and Illustrations. Price 5s. net.*

A useful summary account, touching upon every side of the economic life of Japan.

Japan—Hokkaido. *Z. Ges. E. Berlin* (1916): 34–50, 95–110. **Müller.**

Beiträge zur Kenntnis der Insel Hokkaido oder Jesso. By Dr. Max Müller.

Russia—Siberia—North-East. **Shklovsky and Edwards.**

In Far North-East Siberia. By J. Shklovsky ("Dioneo"). Translated by L. Edwards and Z. Shklovsky. London: Macmillan & Co., 1916. Size 9 × 5½, pp. 264. *Map and Illustrations. Price 8s. 6d. net. Presented.*

Turkey—Travel. **Warfield.**

The Gate of Asia. A journey from the Persian Gulf to the Black Sea. By William Warfield. London: G. P. Putnam's Sons, 1916. Size 8 × 5½, pp. x. and 374. *Illustrations. Price 12s. 6d. net. Presented.*

AFRICA

Nigeria—Vocabulary. **Dalziel.**

A Hausa botanical vocabulary. By Dr. John M. Dalziel. London: T. Fisher Unwin, 1916. Size 9 × 5½, pp. 120. *Price 6s. 6d. net. Presented.*

Sierra Leone. **Newland.**

Sierra Leone. Its People, Products, and Secret Societies. By H. Osman Newland. London: J. Bale, Sons & Danielsson, 1916. Size 9 × 5½, pp. xvi. and 252. *Illustrations. Price 7s. 6d. net. Presented.*

South Africa—Historical. **Molsbergen.**

Reizen in Zuid-Afrika in de Hollandse Tijd. Uitgegeven door Dr. E. C. Godée Molsbergen. 2de deel. Tochten naar het Noorden 1686–1806. (Wergen uitgegeven door de Linschoten-Vereeniging, XII.) The Hague: M. Nijhoff, 1916. Size 10 × 6½, pp. xl. and 306. *Map and Illustrations.*

The second volume of this valuable collection of early travels in South Africa in the Dutch period.

South Africa—Text-book. **Roux.**

Maskew Miller's beginselen der aardrijkskunde van Zuid-Afrika. Door A. E. Roux. Cape Town, (1915). Size 7½ × 5, pp. 104. *Sketch-maps, Sections, and Diagrams. Price 1s. 5d. Presented.*

NORTH AMERICA

Alaska—Hydrology. **Ellsworth, Davenport, and Hoyt.**

U.S. Geol. Surv., Water-Supply Paper [illegible] 1915): pp. 173.

A water-power reconnaissance in south-central A[illegible] By C. E. Ellsworth and R. W. Davenport. With a section on south-east[illegible]ka by J. C. Hoyt. *Map and Illustrations.*

America. **Brooke.**

Letters from America by Rupert Brooke. With a preface by Henry James. London: Sidgwick & Jackson, 1916. Size 8 × 5½, pp. xlii. and 180. *Portrait. Price 7s. 6d. net.*

Unusually realistic sketches of American life and scenery, by the young poet whose death at the front has caused such wide-spread regret.

America—Historical. *Science*, N.S. 44 (1916): 190–195. **Smith.**

The origin of the Pre-Columbian civilization of America. By G. Elliot Smith.

Canada—British Columbia. **Schofield.**
Canada, Geol. Surv., Mem. 76 (1915): pp. vii., 245.
Geology of Cranbrook map-area, British Columbia. By Stuart J. Schofield. *Map and Illustrations.*

Canada—Economic. ——
Commission of Conservation, Canada. Report of the fifth annual meeting, held at Ottawa, January 20–21, 1914. Ditto, sixth, January 19–20, 1915. Toronto, 1914, 1915. Size 10 × 7, pp. ix., 287; x., 333. *Illustrations and Map.*

Canada—Geological Survey. ——
Summary Report of the Geological Survey, Department of Mines, for the calendar year 1915. Ottawa, 1916. Size 10 × 6½, pp. 307. *Maps. Price* 15 *cents.*

Mexico—Historical. **Diaz del Castillo.**
The true history of the conquest of New Spain. By Bernal Diaz del Castillo. Edited . . . by Genaro García; translated . . . by Alfred Percival Maudslay. Vol. 5. (Works issued by the Hakluyt Society, Ser. II. vol. 40.) London, 1916. Size 9 × 5½, pp. xiv. and 464. *Maps and Illustrations.*
See Review in the present number, p. 61.

Mexico and Central America. **Franck.**
Tramping through Mexico, Guatemala and Honduras. Being the random notes of an incurable vagabond. By Harry A. Franck. London: T. Fisher Unwin, [1916]. Size 8½ × 5½, pp. 378. *Map and Illustrations. Price* 7*s.* 6*d. net.*

United States—California—Historical. **Chapman.**
The founding of Spanish California. The North-westward expansion of New Spain, 1687–1783. By Dr. Charles Edward Chapman. New York (London): The Macmillan Company, 1916. Size 9 × 5½, pp. xxxii. and 486. *Portrait and Maps. Price* 15*s. net. Presented.*

United States—Historical. **Cunningham.**
English influence on the United States. By W. Cunningham. Cambridge: University Press, 1916. Size 7½ × 5, pp. xii. and 168. *Price* 4*s.* 6*d. net. Presented.*

CENTRAL AND SOUTH AMERICA

Patagonia—Ethnology. **Lehmann-Nitsche.**
B.A. Nac. Ciencias Córdoba 20 (1915): 103–112.
Noticias etnológicas sobre los antiguos patagones recogidas por la expedición Malaspina en 1789. By Robert Lehmann-Nitsche.

South America—Anthropogeography. *Ymer* (1916): 138–155. **Nordenskiöld.**
Die Anpassung der Indianer an die Verhältnisse in den Ueberschwemmungsgebieten in Südamerika. Von Erland Nordenskiöld. *Sketch-maps and Illustration.*

South America—Historical. **Schuller.**
Smithsonian Misc. Coll. 66 (1916): No. 4, pp. 15.
The Ordáz and Dortal Expeditions in search of El-Dorado, as described on sixteenth-century maps. By Rudolf Schuller. *Facsimile Maps.*

Venezuela—Margarita Island. *B. Union Panamericana* 43 (1916): 32–45. **Booy.**
La isla de Margarita, Venezuela. Por Theodor du Booy. *Illustrations.*

POLAR REGIONS

Arctic—Lancaster Sound. *Petermanns M.* 62 (1916): 140–141. **Franke.**
Die Auffindung des Wrackes [illegible] "Assistance" von den Franklin-Entsatzfahrten 1850–54. Von Rudolf Fr[illegible] *Illustrations.*
During an expedition to the Lancaster Sound Region in company with Captain Bernier the author came upon the remains (as he believes) of Sir Erasmus Ommanney's old ship the *Assistance*, of which he gives photographs.

PHYSICAL AND BIOLOGICAL GEOGRAPHY

Climatology. *American J. Sc.* 42 (1916): 27–33. **Arctowski.**
The pleionian cycle of climatic fluctuations. By H. Arctowski.
A paper by Mr. Arctowski on a cognate subject was noticed in the September number, p. 274.

Geological History. *Sc. Monthly* **3** (1916): 161-169. **Berry.**

The environment of the ape man. By Edward W. Berry. *Illustrations and Sketch-maps.*

Geological History. **Chamberlain.**

The origin of the Earth. By Thomas Chrowder Chamberlain. Chicago (London: Cambridge University Press), 1916. Size 7½ × 5, pp. x. and 272. *Illustrations and Sections. Price 6s. net. Presented.*

Meteorology. **Shaw.**

Meteorological Office. The Weather Map. An introduction to modern meteorology. By Sir Napier Shaw. London: Darling & Sons, 1916. Size 6 × 5, pp. 94. *Maps. Price 4d. Presented.*

Vegetation and Hydrology. **Giandotti.**

Mario Giandotti. Boschi e Acque. Rome, 1916. Size 9 × 6½, pp. 238. *Diagrams. Price 5s.*

A careful study of the relations between vegetation and hydrology (water-flow and water-supply), based chiefly on observations in Italy.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY

Ethnology. **Migeod.**

Earliest Man. By Frederick William Hugh Migeod. London: Kegan Paul, Trench & Co., 1916. Size 8 × 5½, pp. xii. and 134. *Price 3s. 6d. net.*

An attempt to reconstruct the man of the remote past on the analogy of the primitive tribes of to-day.

Historical—East India Company. **Sainsbury and Foster.**

A calendar of the court minutes, etc., of the East India Company, 1655-1659. By Ethel Bruce Sainsbury, with an introduction and notes by William Foster. Oxford: Clarendon Press, 1916. Size 9 × 6, pp. xxxiv. and 388. *Price 12s. 6d. net. Presented.*

A new addition to this admirably edited series of volumes.

Political—Germany and the East. **Lewin.**

The German road to the East. An account of the "Drang nach Osten" and of Teutonic aims in the Near and Middle East. By Evans Lewin. London: Wm. Heinemann, 1916. Size 8½ × 5½, pp. 340. *Maps. Price 7s. 6d. net. Presented.*

GENERAL

Atlantic. *Petermanns M.* **62** (1916): 41-46, 86-92, 128-131. **Arldt.**

Südatlantische Beziehungen. Von Theodor Arldt.

British and Russian Empires. *G.Z.* **22** (1916): 353-371. **Hettner.**

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